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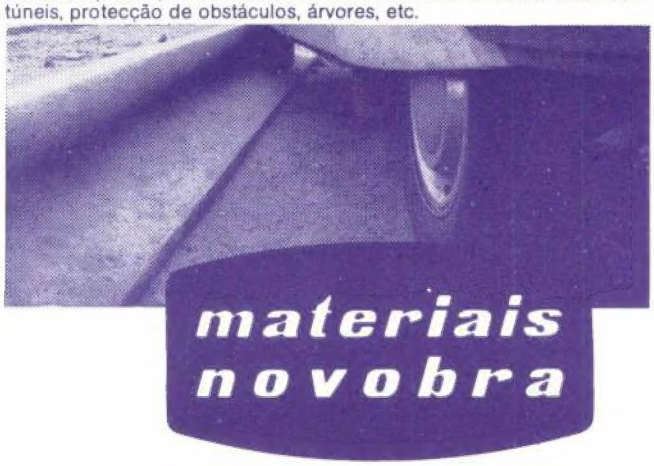

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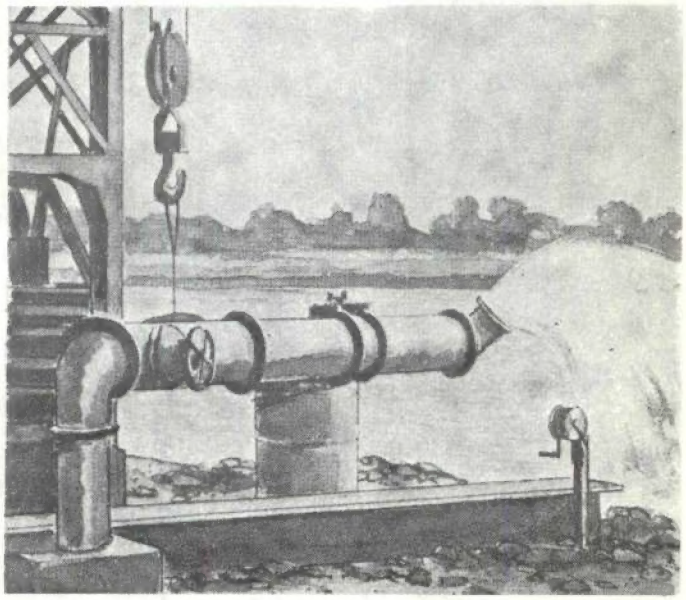

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Estudo da propagação da banda dos 11 GHz para ligações por satélite

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Científica e Tecnológica

RESUMO

Este trabalho descreve as medidas feitas nos arredores de Milão com vista a determinar a viabilidade de comunicações por satélite na banda dos 11 GHz.

Como fonte de sinal, usou-se o ruído galáctico, medindo a atenuação sofrida durante períodos de chuva intensa.

A partir de medidas feitas, foi possível determinar as distribuições cumulativas de atenuação e temperatura de ruído espacial, para o período estivo de 1971.

SUMMARY

This paper reports the measurements carried out in the suburbs of Milan, in order to study the possibility of establishing satellite communications on the 11 GHz band.

It has been measured the irreducible sky noise taken as a signal source. Through these measurements it has been possible the determination of cumulative distributions of attenuation and sky noise temperature for the summer period of 1971.

1 — INTRODUÇÃO

É sabido que a propagação de frequências superiores a 10 GHz é grandemente influenciada pela presença de hidrometeoros na atmosfera.
Por este motivo, vários percursos experimentais têm sido instalados com a finalidade de estudar a viabilidade de utilizar tais frequências em ligações por feixe hertziano.

Nos últimos anos, com o crescente uso dos satélites de comunicações, também se têm desenvolvido estudos de propagação em frequências superiores a 10 GHz usando como fonte de energia o sol ou o ruído galáctico.

Este trabalho descreve os resultados de medidas efectuadas nos arredores de Milão, durante o Verão de 1971, tomando como fonte de energia o ruído galáctico.

Este processo tendo o inconveniente de fazer medidas de potencias muito pequenas, o que implica diversas correcções, tem por outro lado a vantagem de não ser necessário fazer o seguimento do sol.

As medidas que descrevemos culminaram a colaboração do autor no desenvolvimento de um radiómetro do tipo «Diche-switch», encomendado pela Euro Space Research Organization com a finalidade de se estudar a possibilidade de ser lançado um satélite europeu de comunicações na banda dos 11 GHz. Esta colaboração foi prestada com base numa bolsa de estudo da junta Nacional de Investigação Científica e Tecnológica e desenvolvimento no Laboratório de Investigação Francesco Vecchiacchi da GTE em Cassina de Pecchi (Milão).

2 — PRINCÍPIO DE MEDIDA

Como já referido tomou-se como fonte de energia especial o ruído galáctico que na banda dos 11 GHz tem uma temperatura equivalente de ruído de 3,5° K.

Em condições de céu limpo será portanto esse o valor do ruído captado pela antena.

Caso existam hidrometeoros na atmosfera esse valor aumentará em função de sua temperatura e da atenuação por eles introduzida.

Com efeito, se recordarmos as leis de radiação do corpo negro, considerando o estracto de hidrometeoros como um quadripolo com atenuação A, à temperatura T_Q, a temperatura equivalente de ruído aos terminais desse quadripolo será:

$$T_S = \frac{T_G}{A} + T_Q \frac{A-1}{A} \qquad (1)$$

quando na sua entrada aplicamos um gerador de ruído com uma temperatura equivalente T_G. No nosso caso o gerador de ruído é o espaço e portanto $T_G = 3{,}5°$ K.

Consequentemente se medirmos o ruído recebido por um receptor na banda dos 11 GHz e se soubermos a temperatura T_Q dos hidrometeoros, podemos determinar A que é afinal o parâmetro condicionante da ligação.

Como veremos mais à frente a medida não é tão simples quanto esta introdução pode levar a supor, dado que as pequenas potências em jogo nos levam a fazer algumas correcções, devidas à atenuação dos guias de onda que ligam a antena ao receptor e ainda aos factores de ruído dos diferentes componentes.

3 — DESCRIÇÃO SUMARIA DO RADIÓMETRO USADO

Na fig.1, representa-se o esquema de blocos do radiómetro utilizado. O seu principio de funcionamento é o seguinte:

a) Os comutadores I_1, I_2, I_3, I_4 e I_5 são todos comandados simultâneamente. Quando I_1 está ligado sobre a antena, I_2 e I_3 estão abertos e I_4 e I_5 fechados pelo que o sinal recebido passa ao amplificador diferencial através do integrador B. Quando I_1 está ligado sobre a carga padrão, I_2 e I_3 estão fechados e I_4 e I_5 abertos, passando o sinal através do integrador A ao amplificador diferencial.

Se chamarmos V_1 à saída do integrador A e V_2 à saída do integrador B, a saída do amplificador diferencial será kk_1 $(V_1 - V_2)$ em que k_1 é uma constante relativa a todo o sistema que precede o amplificador diferencial e k uma constante relativa ao amplificador diferencial.

V_1 será proporcional ao ruído térmico da carga padrão enquanto V_2 é proporcional ao ruído captado, à parte algumas correcções que veremos adiante. Portanto, a medida de ruído é feita por comparação com o ruído de uma carga padrão de que se conhece perfeitamente a temperatura. Dado que o valor da constante de proporcionalidade k_1 pode variar ligeiramente conduzindo a variações da tensão V_0 à saída do amplificador diferencial, introduz-se um comando automático de ganho (CAG), controlado por V_2, o que equivale a termos uma saída.

$$V_0 = k \frac{V_1 - V_2}{V_2} \qquad (2)$$

O atenuador A_{IF}, como veremos destina-se a fazer a calibração do radiómetro, estando portanto na posição 0 durante as medidas.

4 — CALIBRAÇÃO DO RADIÓMETRO

Durante a calibração, o integrador A recebe o ruído gerado na carga padrão, enquanto o integrador B recebe o mesmo ruído atenuado pelo atenuador de precisão A_{IF}. Pode assim fazer-se a calibração por comparação dos dois valores V_1 e V_2 assim obtidos.

Das considerações feitas no parágrafo anterior, podemos substituir V_1 e V_2 respectivamente por $T_L + T_R$ e $T_T + T_R$ em que:

— T_L é a temperatura equivalente de ruído da carga padrão

— T_R é a temperatura equivalenae do conversor para 70 MHz

— T_T é a temperatura equivalente de ruído à entrada do comutador I_1.

e vem:

$$V_0 = k \frac{T_L - T_T}{T_R + T_T} \qquad (3)$$

Durante a calibração, será:

$$V_1 = V_1$$

$$V_2 = \frac{V_1}{A_{IF}}$$

em que A_{IF} é a atenuação do atenuador de precisão como já vimos.

A tensão à saída do amplificador diferencial será:

$$V_0 = k \frac{V_1 - \frac{V_1}{A_{IF}}}{\frac{V_1}{A_{IF}}}$$

$$= k\ (A_{IF} - 1) \qquad (4)$$

De (3) e (4) obtém-se:

$$A_{IF} - 1 = \frac{T_L - T_T}{T_R + T_T} \qquad (5)$$

que nos permite determinar T_T dado que A_{IF}, T_L e T_R são valores conhecidos.

5 — RELAÇÕES QUE PERMITEM PASSAR DO VALOR DE T_T À ATENUAÇÃO

Devido aos pequenos valores de potencia em jogo, vamos começar por introduzir uma correcção devida a dois factores:

— atenuação dos elementos que ligam a antena ao radiómetro.

— temperatura de ruído da própria antena.

Estes dois factores, conduzem a que a temperatura de ruído galáctico medida em dias de céu limpo é de cerca de 40° K.

Relativamente à antena há a acrescentar que estando apontada a 45°, parte do seu diagrama de radiação capta ruído de origem terrestre, portanto com uma temperatura média da ordem de 290° K, correspondente

a uma temperatura ambiente de 17° C. Por este motivo, houve que estudar pormenorizadamente o diagrama de radiação da antena concluindo-se que, a 45° de inclinação, 5% do valor por ela captada se refere a ruído de origem terrestre.

Então a temperatura de ruído T_T à entrada do receptor obtém-se aplicando sucessivamente a expressão (1) aos vários componentes existentes entre a antena e essa entrada. Sera:

$$T_T = \frac{T_A}{A_f\ A_c} + \frac{A_f - 1}{A_f\ A_c}\ T_f + \frac{A_c - 1}{A_c}\ T_c \qquad (6)$$

em que:

— T_f é a temperatura equivalente de ruído do feeder

— A_f é a atenuação do feeder

— T_c é a temperatura equivalente de ruído do circulador do comutador I_1 (Dicke switch)

— A_c é a atenuação do mesmo circulador

— T_A é a temperatura equivalente de ruído da antena que é dada por:

$$T_A = h\ T_S + (1 - h)\ T_0 \qquad (7)$$

em que T_0 é a temperatura ambiente, h é a fracção do diagrama da antena efectivamente apontado para o espaço, e T_S a temperatura equivalente de ruído do espaço.

Considerando que $T_f \simeq T_c$ a expressão (6) resulta:

$$T_T = \frac{T_A}{A} + \frac{A - 1}{A}\ T_f \qquad (8)$$

em que $A = A_f\ A_c$

Finalmente, aplicando a relação (1) ao estracto atenuador, vem:

$$T_s = \frac{T_G}{A_m} + \frac{A_m - 1}{A_m}\ T_m \qquad (9)$$

em que T_G é a temperatura de ruído galáctico na banda de frequências considerada, A_m a atenuação do estracto atenuador, e T_m a sua temperatura.

Portanto, a partir da medida de T_T, podemos determinar A_m desde que saibamos T_0 e T_m. Basta aplicar sucessivamente as expressões (7), (8) e (9).

6 — ANÁLISE DOS DADOS COLHIDOS

O equipamento entrou em funcionamento em 15 de Julho, o que permitiu fazer ainda a recolha de dados de grande parte do período estivo. Registou-sce simultâneamente a tensão de saída do amplificador diferencial, a temperatura ambiente e a temperatura da carga padrão.

O registo de temperatura ambiente foi feita com uma precisão de ± 2° C e o da temperatura da carga padrão com uma precisão de ± 0,6° C.

O registo da tensão de saída do amplificador diferencial foi conduzido com uma precisão equivalente a:

— ± 11.8° K para T_A = 20° K

— ± 4.9° K para T_A = 250° K

O facto de o erro ser maior para os valores mais baixos medidos resulta de a calibração ter sempre sido feita com a carga padrão quente por ainda não estar disponível a carga padrão fria.

Com a utilização da carga padrão fria pensa-se conseguir baixar o erro para ± 6.3° K para T_A = 20° K.

No entanto, porque se pretende obter a estatística dos valores de atenuação elevados, para podermos estudar a viabililidade de ligações por satélite em tais frequências, o erro cometido na medida das baixas atenuações tem pequeno significado.

Tentou-se também determinar a correlação entre a precipitação e a correspondente atenuação, aproveitando o registo simultâneo de um pluviómetro instantâneo de balanceiro situado a cerca de 300 m da antena e pertencente a um percurso experimental, para estudos de propagação troposferica na mesma banda de frequências.

Nas figs. 2, 3 e 4 mostram-se as distribuições cumulativas da temperatura de ruído especial medida nos meses de Julho, Agosto e Setembro. As figs. 5, 6 e 7 apresentam as mesmas distribuições cumulativas convertidas em atenuação.

Na fig. 8, dá-se o erro provável cometido nas medidas devido a instabilidade na calibração.

Finalmente na fig. 9 mostra-se um registo simultâneo de precipitação e atenuação, podendo notar-se a correlação entre as duas grandezas embora a certos picos de atenuação não correspondam picos de precipitação. Tudo leva a crer que tais picos corresponderão aos instantes em que estando já a chover a sul da antena e no percurso interessado, a chuva ainda não atingiu o pluviómetro.

Para determinação da temperatura do estracto atenuador, seguiu-se a indicação de Altshuler, Falcon e Wulfsberg(*):

— quando a atenuação atinge os 30 dB, pode tomar-se $T_m = T_0$;

— para uma atenuação inferior a 5 dB, T_m é aproximadamente constante e inferior a T_0, podendo usar-se a expressão:

$$T_m = 1.12\ T_0 - 50 \qquad (10)$$

— para valores intermédios de atenuação deverá ser feita a interpolação entre a recta $T_m = T_0$ e a recta definida pela expressão (10).

7 — CONCLUSÕES

Conforme se pode concluir dos resultados obtidos as ligações por satélite na banda dos 11GHz são possíveis, sendo de prever atenuações inferiores às esperadas em ligações de feixe hertziano, o que era de esperar em face do menor comprimento de estracto atenuador atravessado.

(*) Altshuler, Falcon, Wulfsberg: Atmospheric effects on propagation of milimeter wavelengths, IEEE Julv 1968 page 83-90.

Como também seria de prever existe uma correlação estreita entre o desenvolvimento no tempo de um aguaceiro e o correspondente desenvolvimento no tempo da atenuação. As pequenas diferenças constatadas poderão resultar da imprecisão na medida da precipitação, quer pelo processo e tipo de equipamento (pluviómetro de balanceiro) quer ainda por não dispôrmos de pluviómetros ao longo do trajecto que permitissem um levantamento das intensidades de precipitação em vários pontos.

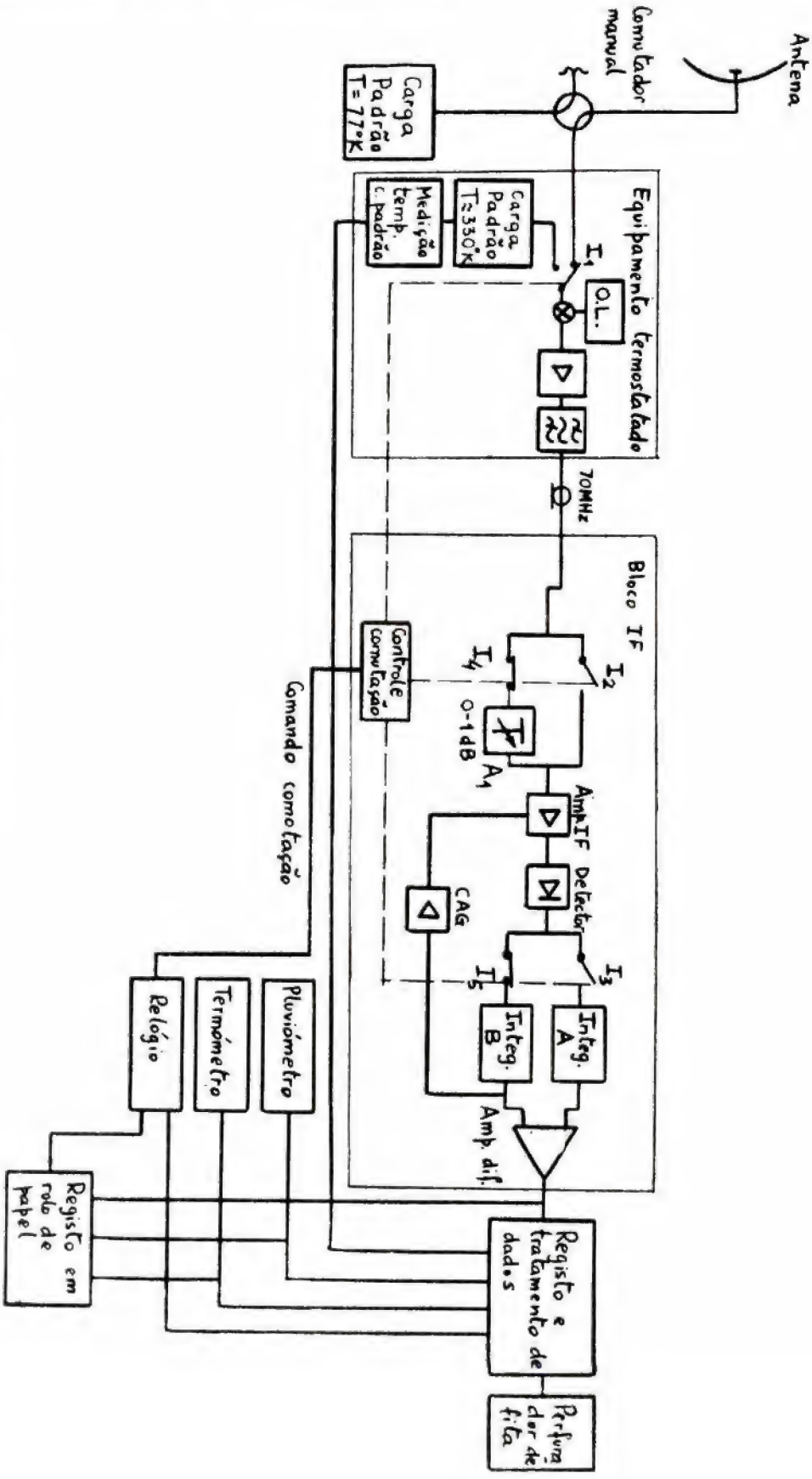


FIG. 1 — Esquema de blocos de um radiómetro Dicke-switch

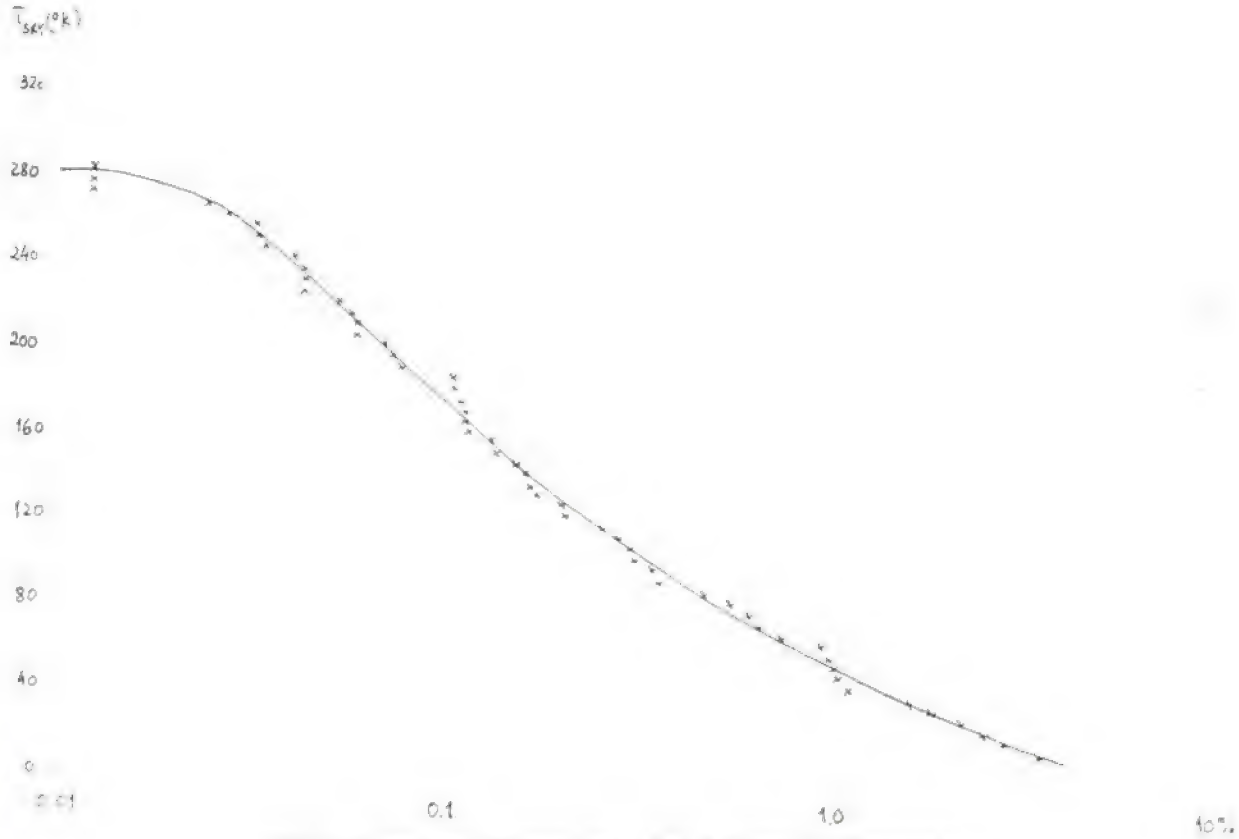


FIG 2 — Percentagem de tempo para o qual a ordenada é ultrapassada

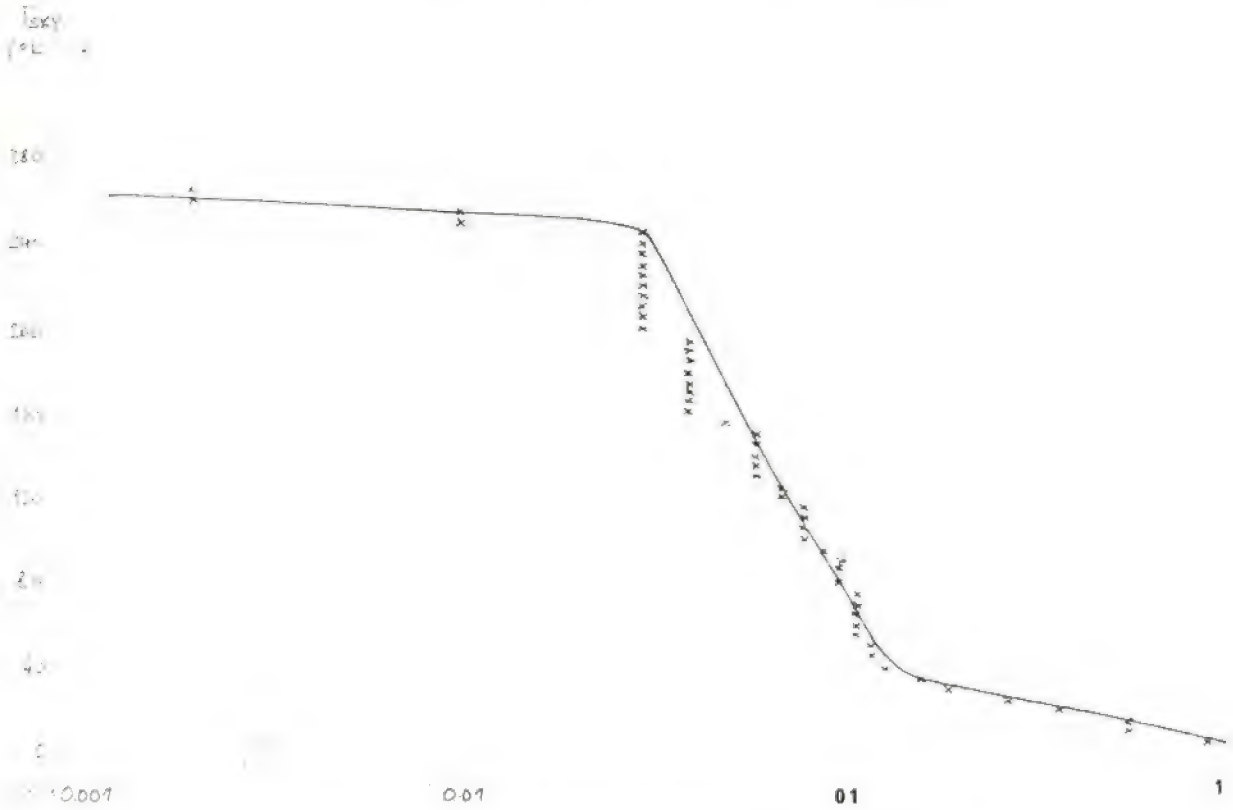


FIG 3 — Percentagem de tempo em que a ordenada é ultrapassada

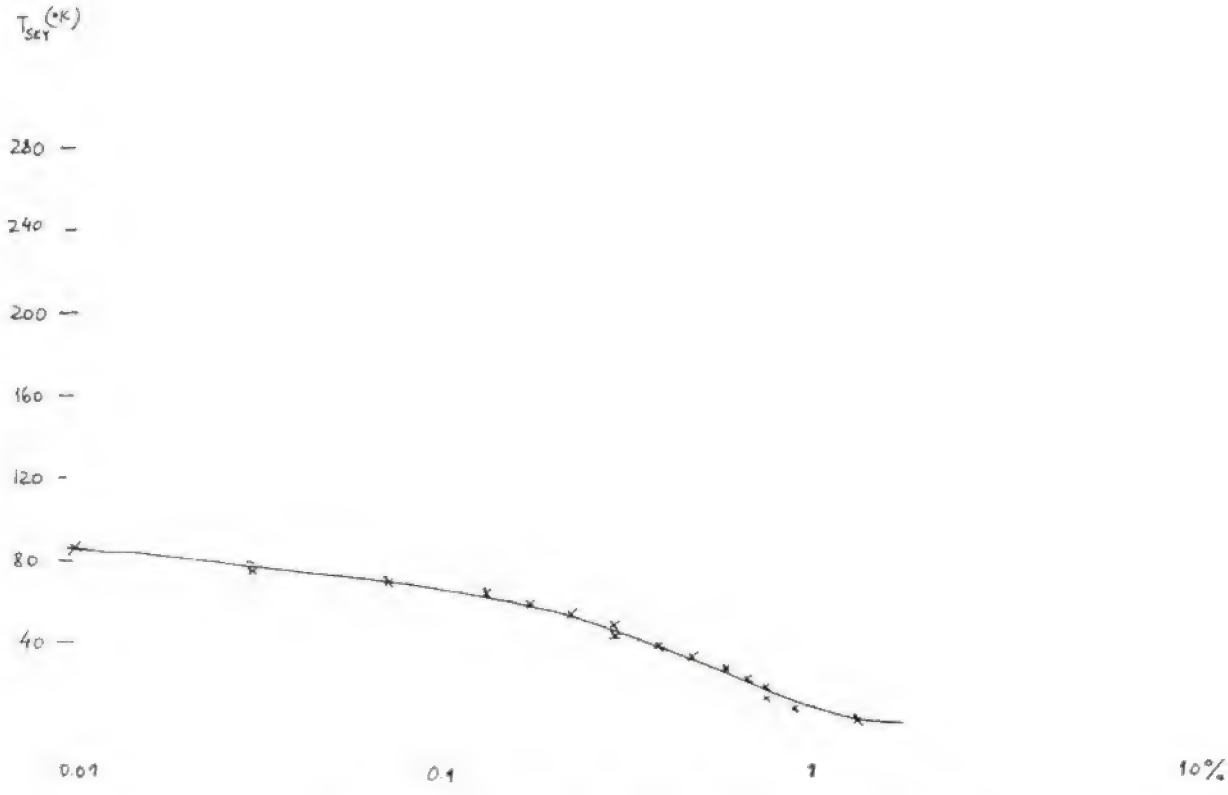


FIG 4 — Percentagem de tempo para que a ordenada é ultrapassada

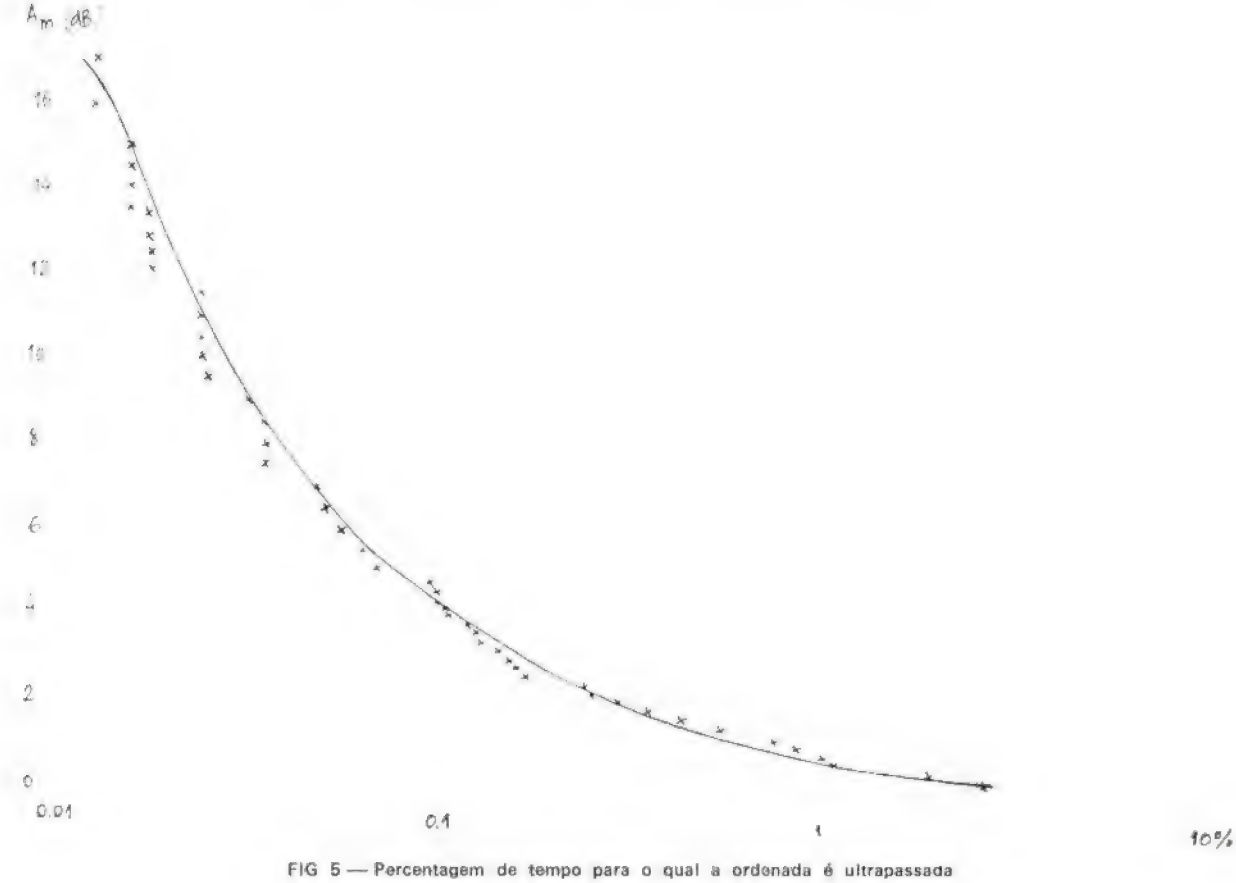


FIG 5 — Percentagem de tempo para o qual a ordenada é ultrapassada

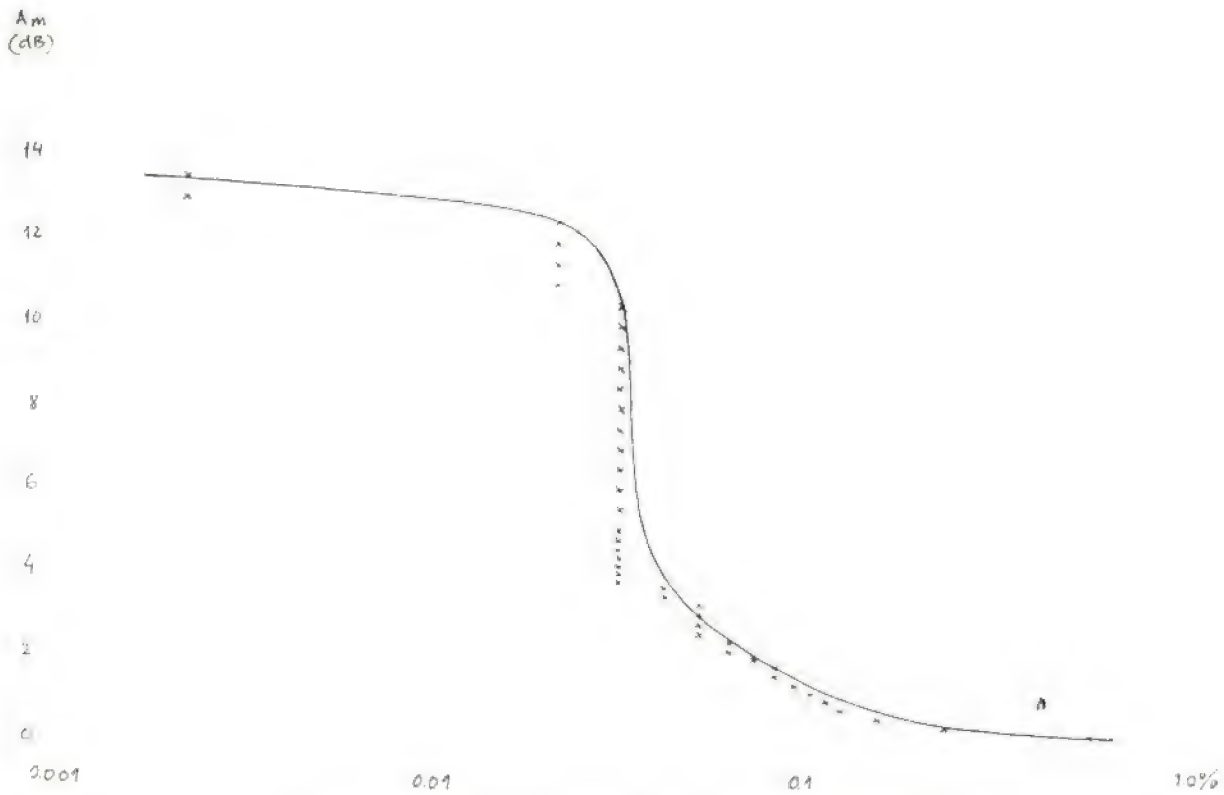


FIG 6 – Percentagem do tempo para que a ordenada é ultrapassada

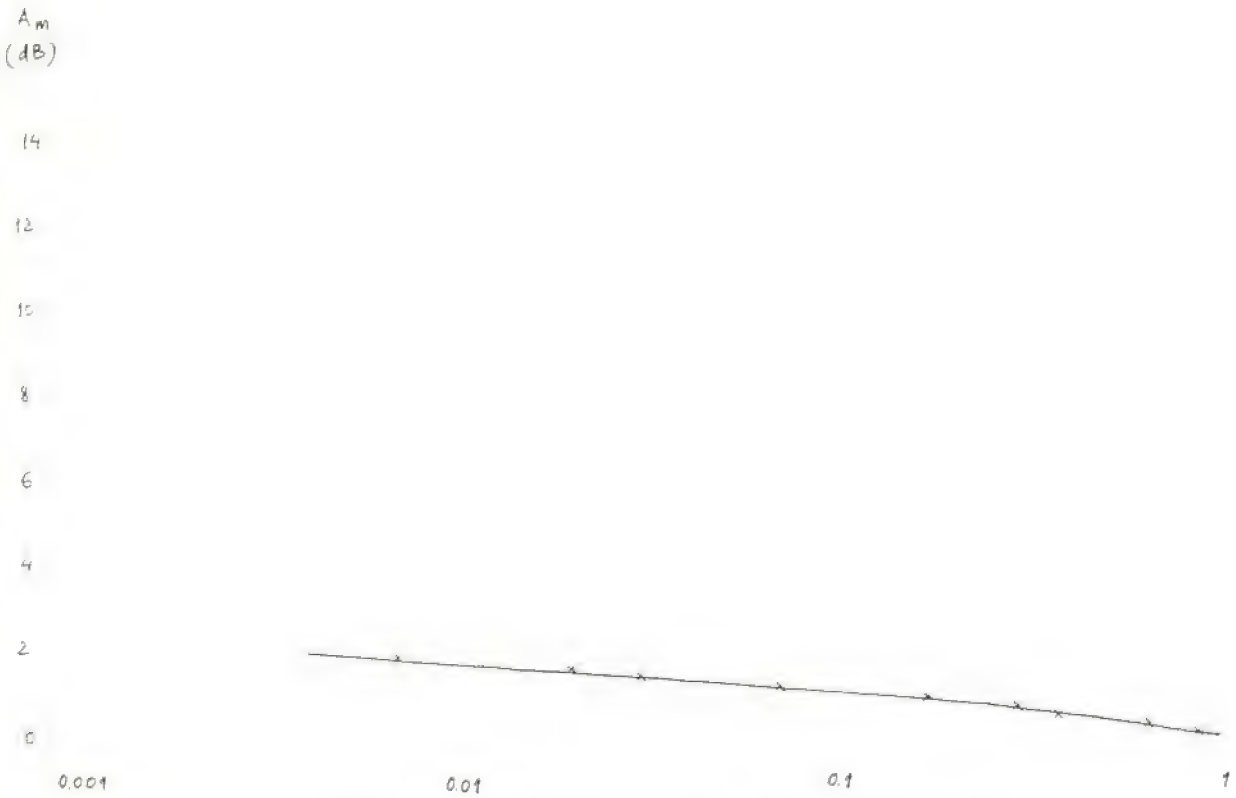


FIG 7 — Percentagem de tempo para que a ordenada é ultrapassada

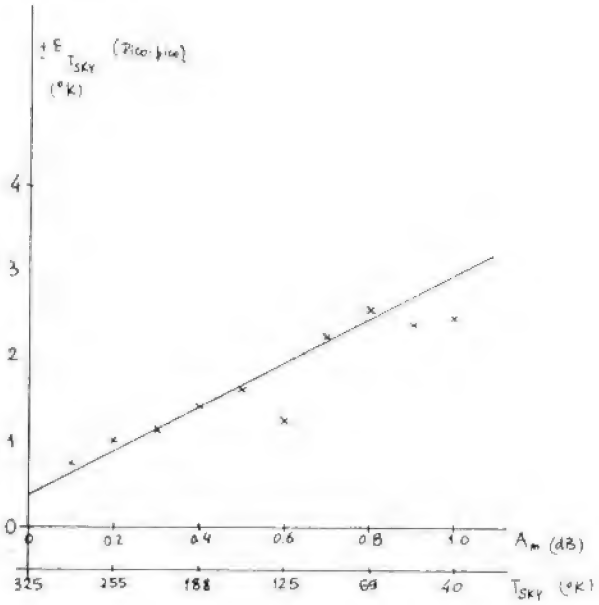

± ε T_SKY (°K) (Pico-pico)
4
3
2
1
0
0
0.2
0.4
0.6
0.8
1.0
A_m (dB)
325
255
188
125
69
40
T_SKY (°K)

FIG. 8

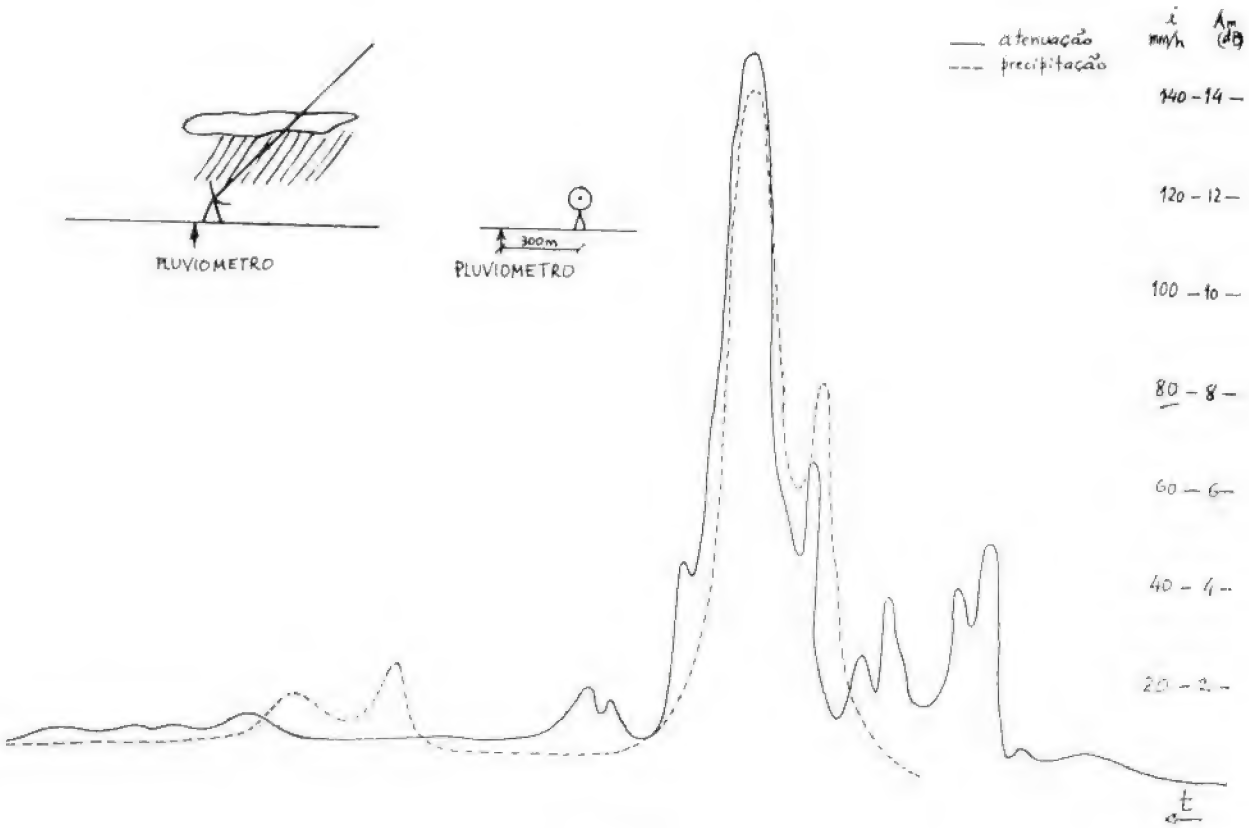
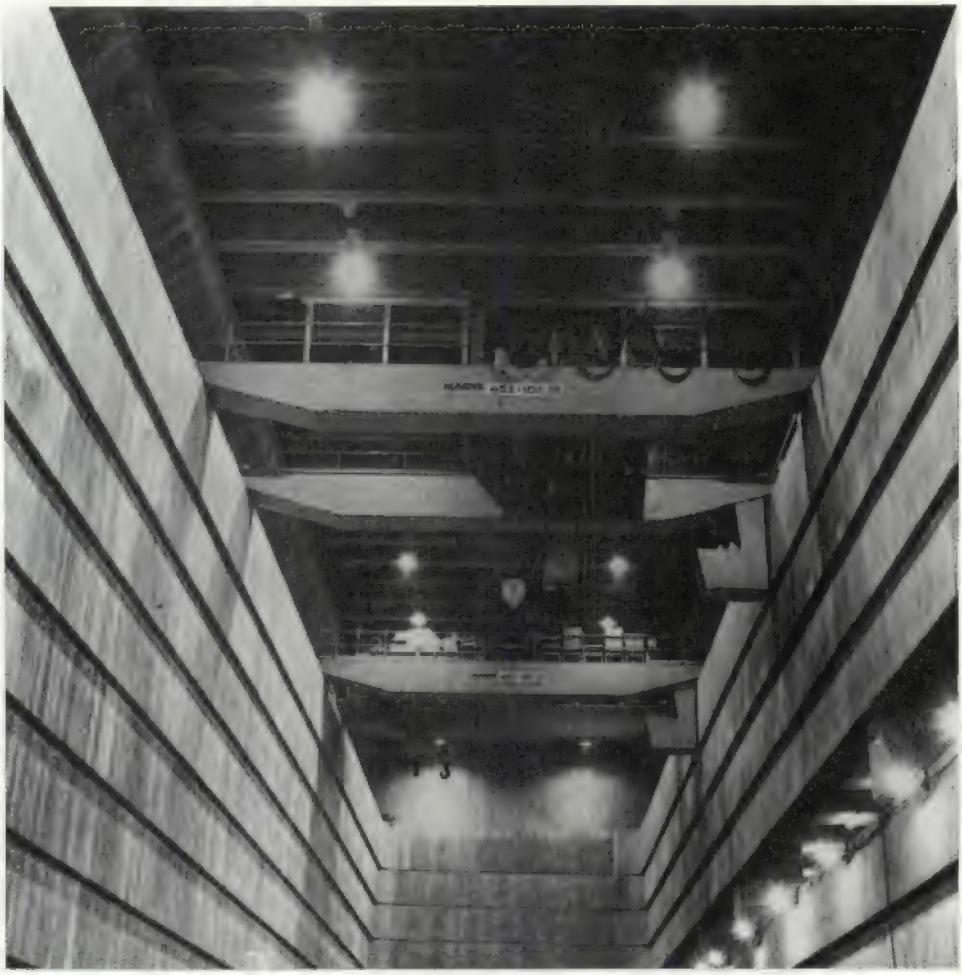

atenuação
precipitação
i mm/h
A_m (dB)
140 - 14
120 - 12
100 - 10
80 - 8
60 - 6
40 - 4
20 - 2
t
PLUVIOMETRO
300m
PLUVIOMETRO

FIG. 9

MAGUE



«2 Pontes rolantes eléctricas de 45t-10t/12m em serviço na Central da Régua, da Companhia Portuguesa de Electricidade».

PONTES ROLANTES, GUINDASTES E APAR. DE ELEVAÇÃO ESPECIAIS	*Projecto e fabrico*
TURBINAS HIDRÁULICAS	*Fabrico segundo licença de A. C. M. de Vevey, S. A.*
TURBINAS A VAPOR	*Fabrico segundo licença de Brown Boveri, Cie.*
CALDEIRAS A VAPOR	*Projecto e fabrico segundo licença de Foster Wheeler, Co.*
EQUIPAMENTOS E INSTALAÇÕES INDUSTRIAIS	

CONSTRUÇÕES METALOMECANICAS **MAGUE** S.A.R.L

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TORRES VERMELHAS

LOURENÇO MARQUES

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DOIS DOS MAIS ALTOS EDIFÍCIOS DE PORTUGAL
Execução total com moldes deslizantes

PERFEIÇÃO TÉCNICA • RAPIDEZ DE EXECUÇÃO

CONSTRUÇÕES TÉCNICAS, S.A.R.L.

C. D. U. 531.7.083:533.6.015

Medições de velocidade efectuadas na zona de recirculação a jusante de um disco.

Measurements in the region of recirculation behind a disc

D. F. G. DURÃO
J. H. WHITELAW

SUMÁRIO

São apresentadas medições da componente axial da velocidade, efectuadas a jusante de um disco colocado perpendicularmente a um jacto de ar dando-se atenção especial à zona de recirculação. As medições foram obtidas com um anemómetro de laser incorporando uma célula acusto-óptica, a qual permitia modular a frequência do raio laser e, por conseguinte, obter medições em regiões de velocidade muito perto de zero e de alta intensidade de turbulência.

Foram usadas três maneiras diferentes de analisar o sinal saido do fotomultiplicador e os resultados foram bastante coincidentes. Duas delas foram baseadas no analisador de frequências; uma usando-o no modo analógico usual e outra usando-o juntamente com um contador de impulsos. O terceiro método usado foi o de medir a frequência de cada um dos sinais doppler e «on-line» de modo a obter os valores da média e do desvio padrão.

ABSTRACT

Measurements of the axial velocity component are reported downstream of a disc baffle surrounded by annular jet. Particular attention is paid to the recirculation zone. The measurements were obtained with a laser anemometer incorporating an acousto-optic cell which allowed light-frequency shifting and, therefore, measurements in regions of near zero velocity and high turbulence intensity. Three signal-processing arrangements were used and yielded measurements which were in close agreement. Two of the signal processing arrangements made use of a frequency analyser; first in the normal analogue manner and second in a counting mode. The third arrangement made use of a computing counter.

1 — INTRODUCTION

The purpose of this paper is to describe experience obtained in measuring, with a laser anemometer, in the region of recirculating flow behind a disc baffle and to present measurements obtained inside and outside this region. The flow situation was that of an annular jet of air, figure 1, and is relevant to blunt-body stabilised flames: it is, therefore, intended to extend the measurements reported here to include measurements in a flame stabilised on the same geometrical arrangement.

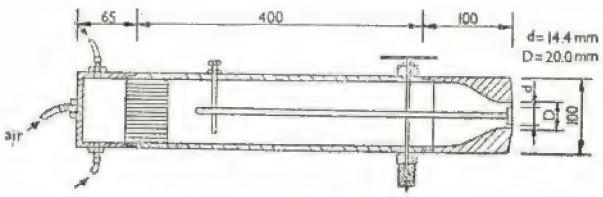


Figura 1 — Geometrical configuration

The outer and inner diameters were respectively of 20.0 mm and 14.4 mm and the initial velocity was 26.9 m/s. The present measurements include a centre-line and radial distribution of the axial mean-velocity component and the corresponding normal stress: the skewness and flatness factors and the probability distribution are presented for the centre-line measurements. The distributions pay particular attention to the recirculation region and allow associated difficulties of measurement to be determined and overcome.

Measurements in regions of recirculating flow require that problems related with directional ambiguity and finite velocity fluctuations occuring at locations of zero or near zero mean velocity be overcome. The former difficulties are present with traditional instrumentation such as pressure and hot-wire probes and have allowed measurements only in those regions of flow where the direction of flow could be determined by examination of the overall pattern of results, for example, references 1 and 2. Even in such cases, the probability that the probe interfered with the flow is large and the

high turbulence intensities render the interpretation of the signal difficult: consequently, the associated measurements must be regarded with caution. The directional ambiguity problem can be overcome with laser-anemometry instrumentation as has been pointed out for example in references 3, 4, 5, 6 and 7 by arranging that two light beams of different frequencies cross; the practical result is a region of light interference which move with an effective velocity corresponding to the difference in frequency between the two beams. References 3 to 7 describe ways in which this frequency shift can be arranged.

An acousto - optic cell was used to remove the directional ambiguity in the present experiments and, in common with alternative techniques, also results in effective ratios of Doppler-frequency fluctuations to mean frequency which are smaller than the corresponding ratios of velocity fluctuations to mean velocity. Thus, provided no other problems arise, precise measurements can be obtained at high turbulence intensities. Related measurements have previously been obtained, using a Kerr cell and a rotating grating for frequency shifting, and are reported in references 8, 9 and 10.

Preliminary tests in a free jet indicated that artificial seeding can introduce bias errors: these results are presented here and, partly as a consequence of them, the resulting large proportion of time for which there was no signal and the very large range of frequencies associated with any of the measurements obtained near the recirculation region, required the use of individual sampling, signal- processing arrangements. Three signal--processing arrangements based on a frequency analyser used in the normal manner (11) and as a countig system and a computing counter were used and allow a comparison of their relative merits.

The optical and signal-processing arrangements are described in greater detail in the succeeding sections. The results are subsequently presented and coupled with a discussion of their precision. The paper closes with a summary of the more important conclusions.

2 — OPTICAL ARRANGEMENT

The optical arrangement is shown on figure 2. It comprised a Spectra-Physics Model 164 laser, operated with a wave length of 488.0 x 10^{-9} m and a power of approximately 500 mW; an acousto - optic cell with a crystal driven at 8.7 MHz; a four mirror arrangement to produce parallel beams of light, separated by 70 mm; and a focussing lens of 100 mm diameter and 250 mm focal length. The light collecting system comprised a 100 mm focal length lens of 40 mm in diameter with a 0.70 mm diameter pin hole located in front of the photomultiplier cathode (EMI 9658A). The flow configuration was located in the region of the crossing of the two light beams and mounted on a three-dimensional traverse

The two first order shifted beams from acousto - optic cell were used as the transmitted light beams and had frequencies which were separated by 17.4 MHz; this, with the present angle between the beams of 16.1 degrees, implied that zero frequency corresponded to a velocity of — 30.4 m/s: the fringe spacing was 1.75 μm. The light-collecting arrangement was arranged to view a control volume of approximately 0.7 mm in length and 0.1 mm in diameter. In those measurements, where high negative velocities were not expected, a frequency shift of 8.7 MHz was obtained from the first and zero order shifted beams and resulted in probability distributions such as that shown on figure 3. The acousto - optic cell made use of a 1 inch diameter, X-cut crystal gold plated along a 0.25 inch wide strip. It was driven by an oscillator with a power of approximately 1 Watt and caused travelling accoustic waves in distilled water. The optimum efficiency of the cell was determined by rotation of the cell relative to the incident beam and fine adjustment of the oscillation frequency. Detailed information about the design of the cell is in reference 7.

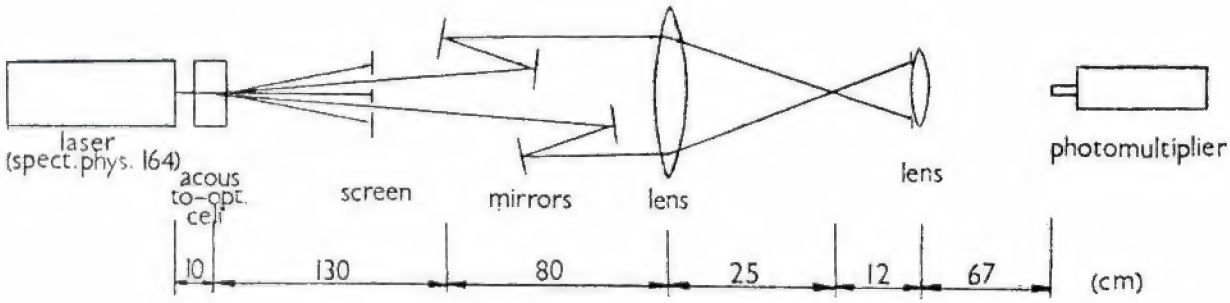


Figure 2 — Optical arrangement

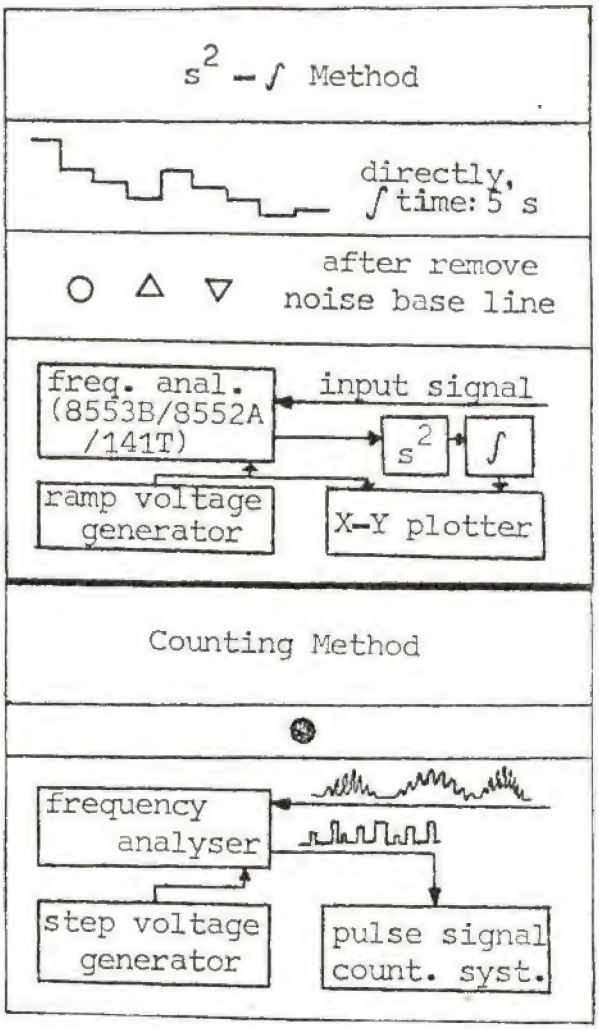
3 — SIGNAL-PROCESSING ARRANGEMENTS

The signals from the photomultiplier were high--pass filtered (TTE Electronics H71B: — 3db at 1 MHz and 3 MHz with attenuations of 60 db per octave), amplified (Hewlett-Packard 461A) and passed to the frequency analyser (Hewlett Packard 8553B/8552A/ /141T) or to the computing counter (Hewlett Packard 5360A).

The frequency analyser was operated in two ways. In the first of these, the instrument was operated in the

conventional manner (11) with the signal from the frequency analyser externally squared (DISA 55D35), integrated (DISA 52B30) and recorded on an X-Y plotter. The analyser and plotter were swept externally to allow sweep times of the order of 10 minutes. The resulting plots were digitised and processed on a computer to yield mean velocity and the corresponding rms values. Figure 3 shows three typical probability distributions measured at the same location ($x/D = 5.22$, $r/D = 0$) with 8.7 MHz shift and at different times: they indicate a typical reproducibility. These distributions, were corrected for base-line noise as indicated and, after processing, maximum deviations from their mean and rms values of 0.5% and 1.5% were respectively obtained. As the region of zero mean velocity is approached, similar magnitudes of zero reproducibility require proportionately longer integration and sweep times: this is associated with the number of particles and consequet Doppler signals, required to define the distribution.

The probability distribution indicated on figure 3 and measured by a counting procedure was also obtained with the frequency analyser but operated in a counting mode. At predetermined centre frequencies, linearly spaced, and with preset and constant bandwidths over the range of signal frequencies (usually 30 kHz or 100 kHz), the number of signals observed in a predetermined time (usually 30s or 60s) were counted and yielded a probability distribution of signal frequencies. The centre frequencies, bandwidths and times varied according to the region of the flow. Each probability distribution was made up of approximately 10^6 signal counts. This procedure was slower than that described previously but



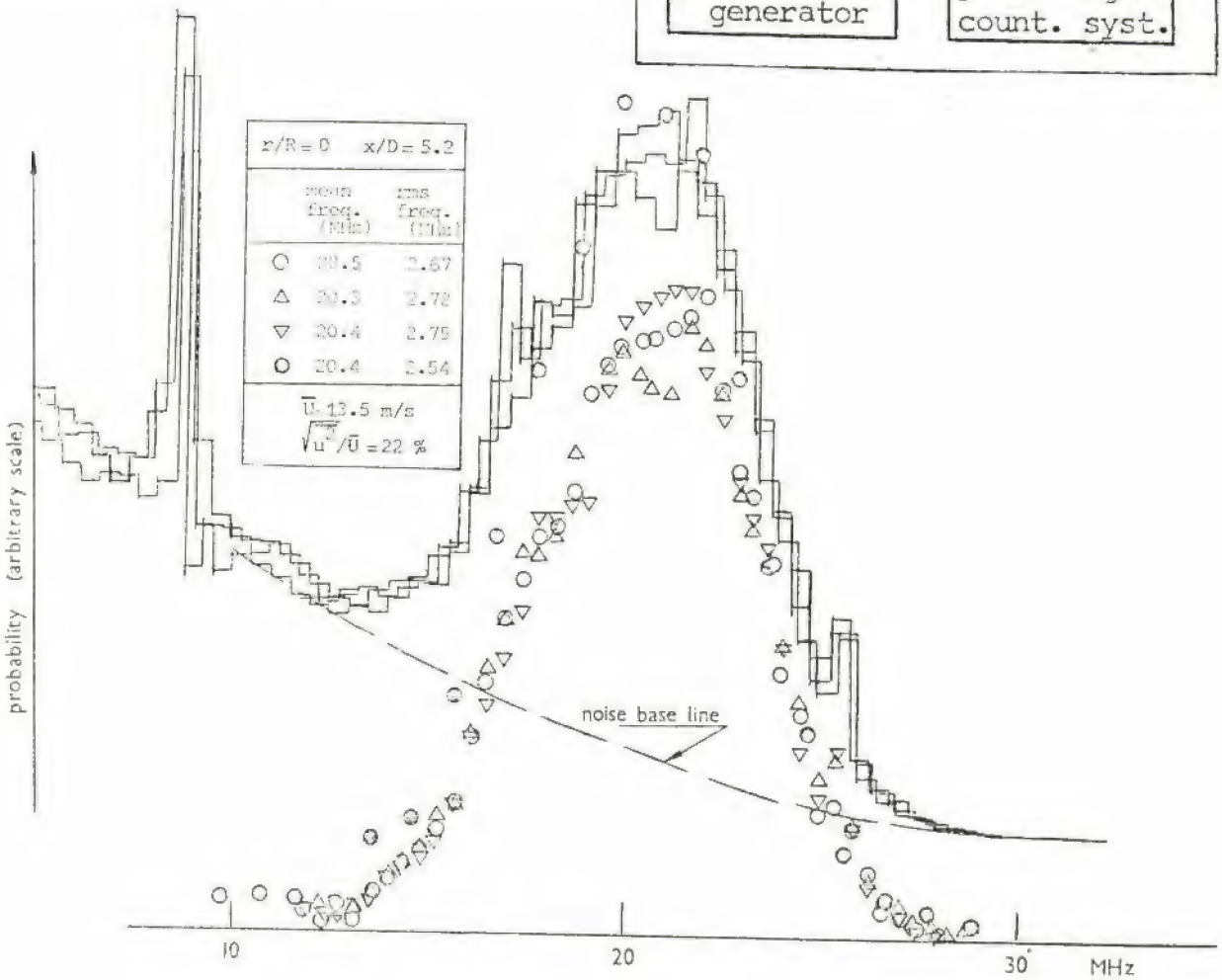


Figure 3 — Probability-density distributions from analogue frequency analysis and counting

allowed those features of the instrument relating to its analogue operation and the ambiguities associated with baseline noise to be dispensed with while taking advantage of the sharpness of the filters (60 db per octave). The probability distribution measured in this way and recorded on figure 3 led to mean and rms values which deviated from the mean of those obtained by conventional frequency analysis by 0.5% and 4% respectively.

The third signal-processing arrangement made use of the Computing Counter. The instrument was operated with a logic circuit which set a minimum measuring time and a discrimination level. A signal with an amplitude above the discrimination level armed the counter which began to count at the next zero crossing: the count stopped at the zero crossing observed immediately after the set time or after 32 fringes, which ever was greater. The exact time and the number of zero crossings provided the required signal frequency. The use of 32 fringes was required by the instrument which can operate with fewer fringes only if the signal frequency is less than approximately 14 MHz. Each mean and rms value was made up of approximately 2500 signal counts. In contrast to the operation of the computing counter as described in reference 12, electronic-signal mixing was not employed; the width of the distributions measured not employed; the width of the distrbutions measured in and around the region of recirculation precluded shifting the frequencies to lower values. A direct result was the need to operate the computing counter with 32 cycle counts and consequently incressed possibility of error; erroneous counts were rejected by subsequent observation.

4 — RESULTS AND RELATED DISCUSSION

Before attempting measurements in the annular jet flow, the influence of particle seeding was investigated. A free jet of air was arranged to allow seeding with atomised silicone oil and measurements with the present optical arrangement across an axial plane at a location

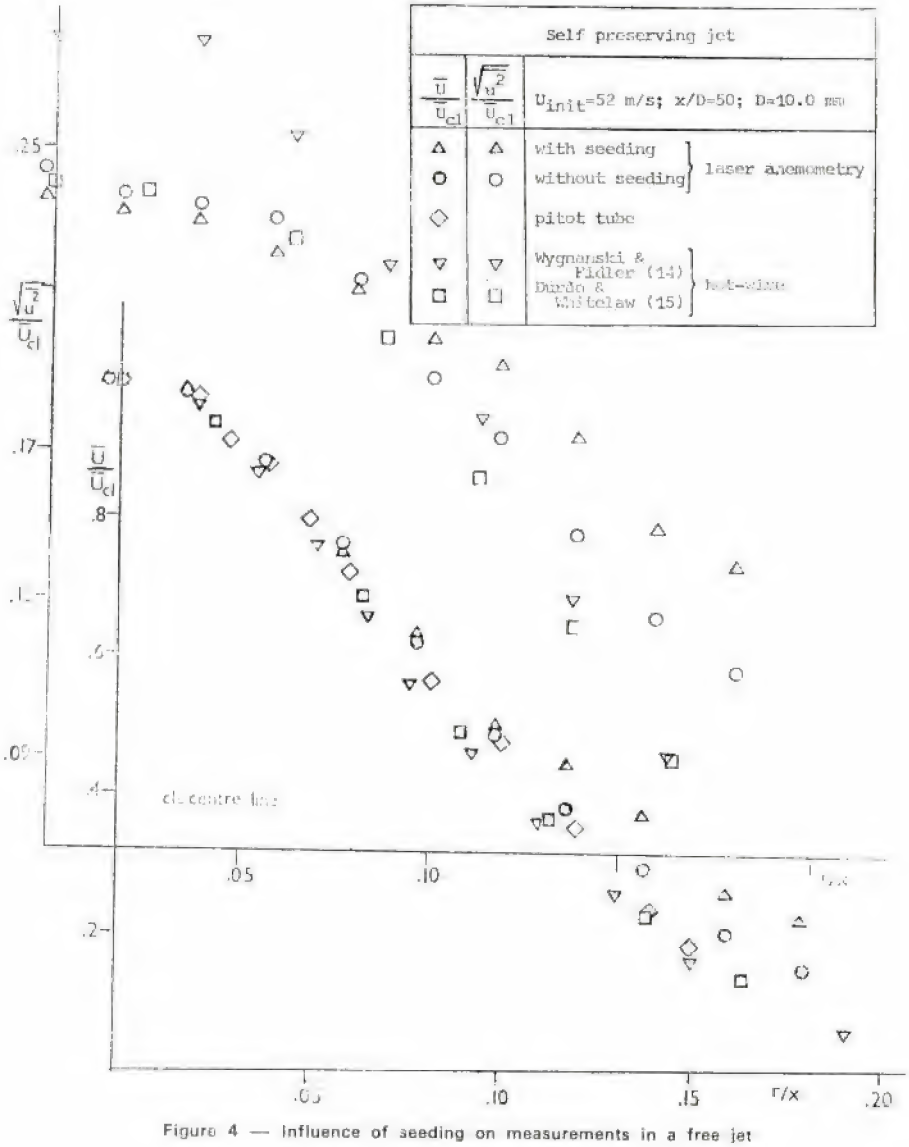


Figure 4 — Influence of seeding on measurements in a free jet

50 diameters from the jet exit. The frequency analyser was used, in its counting mode, to make measurements at different radial locations with and without seeding.

Figure 4 shows the results of this preliminary investigation and confirms the presence of errors due to the seeding. At the centre line tere in no significant difference between the results obtained with and without seeding but towards the edge of the jet the differences in the mean and rms measurements amount to 5% and 10% respectively of the centre line value. The values measured with the laser anemometer, close to the edge of the jet, are higher than those obtained with the hot-wire anemometer and pitot tube whereas the directional sensitivity of the laser anemometer might have been expected to result in lower values. This is not true of the measurements of reference 13 and it remains to explain the differences; it may be that they are associated with the bias errors referred to in reference 16. It is probable, however, that the assumption that the laser anemometer recognises more fast-moving particles than slow moving particles, as indicated in reference 16, is not the only source of bias errors. The signal amplitude is affected by particle velocity with an opposite bias to that described in reference 16. Polydispersed particle-size distributions due to the previously mentioned two possible errors, may result in a third bias error which again will be opposite in sign to that referred to in reference 16. Further work is undoubtedly necessary to resolve the uncertainty.

The results shown on figure 4 confirm, by their agreement with the centreline measurements of previous investigations, that the optical arrangement, incorporating the acousto-optic cell, does not lead to erroneously high rms values.

Values of mean velocity and the corresponding normal stresses measured along the centre line are shown on figure 5. The mean-velocity values pass through zero at a distance of approximately 1.1 baffle diameters from the exit plane, attain a maximum value at approximately 2.2 jet diameters and decrease at further downstream distances. The non-dimmensional normal stress indicates a related distribution; it increases to infinity at the location of zero mean velocity, decays to approximately 13% and rises again to asymptote to a fullydeveloped jet value of approximately 25%.

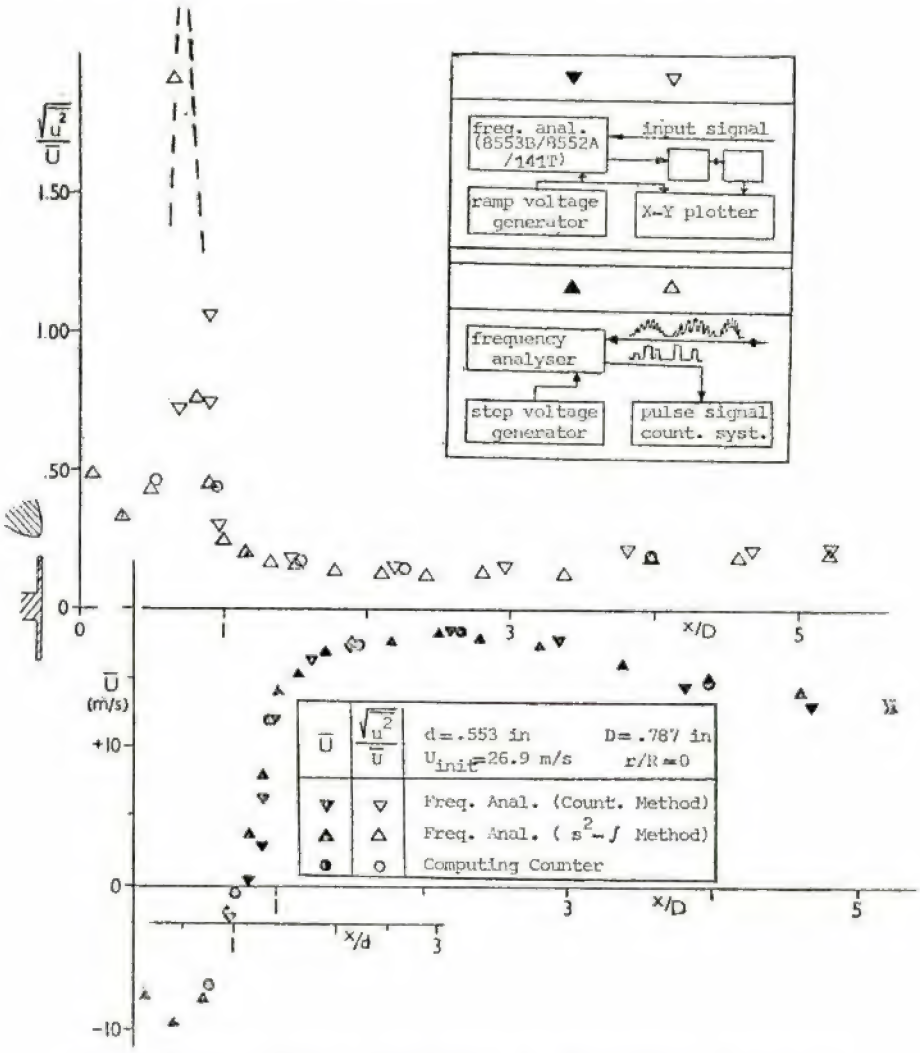


Figure 5 — Centre-line values of mean velocity and normal stress in an annular jet

Figure 6 presents probability distributions, obtained with the frequency analyser operating in the counting mode and at locations along the centre line of the flow between 0.1 and 2.68 jet diameters which encompass the region of zero mean velocity. The corresponding mean and correlation values have been evaluated and are noted on the figure. The large values of negative mean velocities and rms levels demonstrate the need for light frequency shifting and indicates that electronic--signal-frequency shifting is not useful with the present angle between the transmitted light beams due to the range of frequencies present in the distributions. It is of interest to note that, even in the presence of very high values of normal stress, the skewness and flatness factors indicate near-Gaussian distributions.

A radial profile of mean axial velocity and the corresponding normal stress is shown on figure 7 and again encompasses the region of recirculating flow. The comparatively low rms value recorded downstream of the centre of the annular jet helps to confirm that the acousto-optic cell has not contributed a false rms value of significant magnitude due, for example, to distorted fringes.

Figures 5 and 7 show that in general the agreement of the results obtained by the three methods is good.

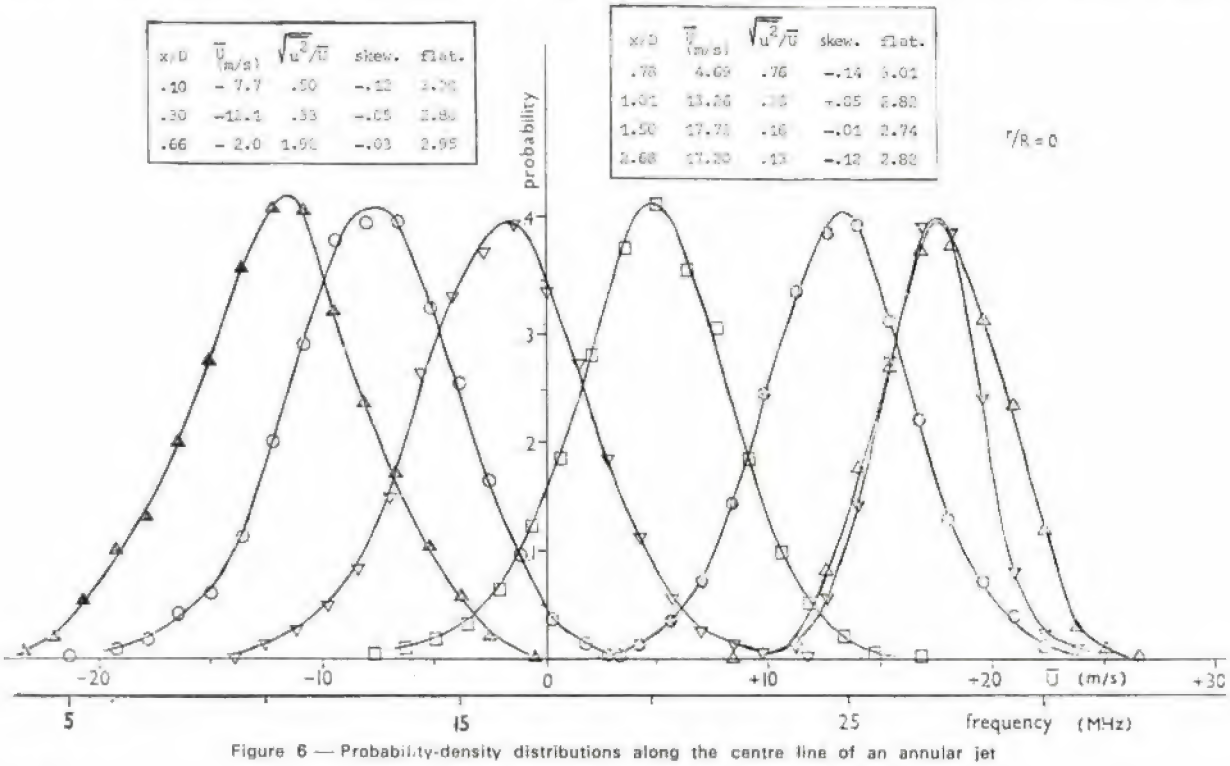


Figure 6 — Probability-density distributions along the centre line of an annular jet

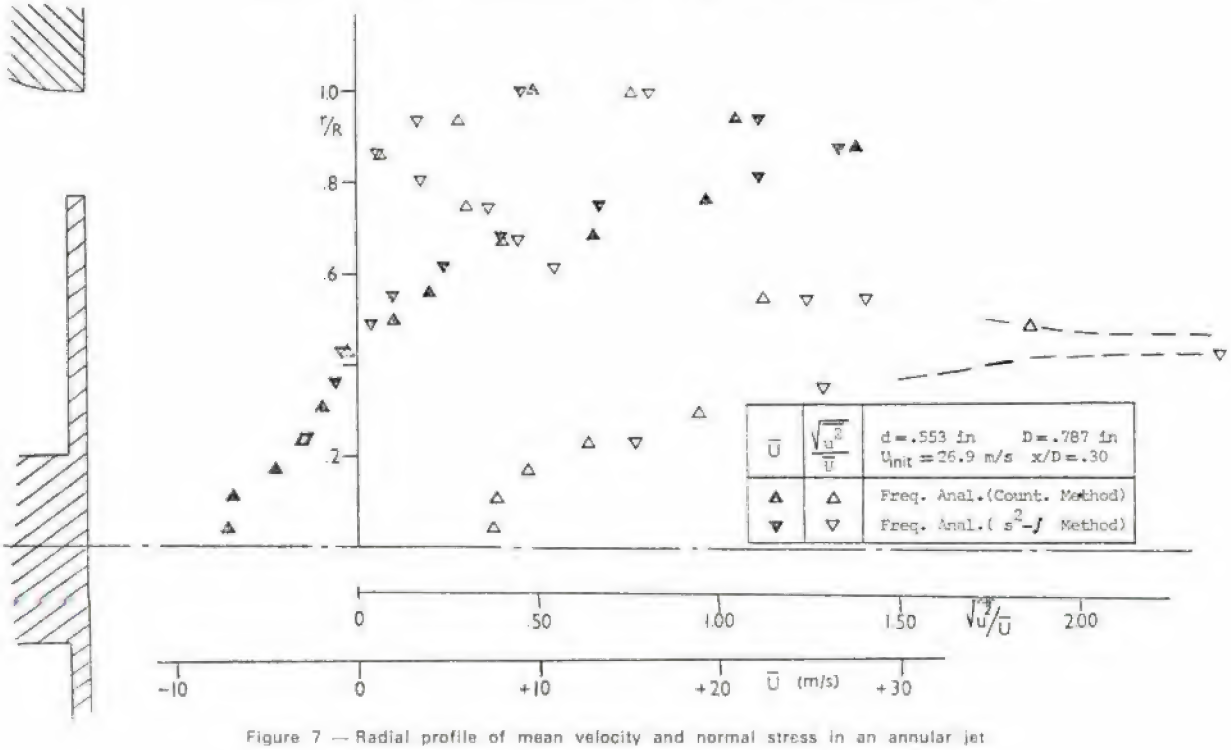


Figure 7 — Radial profile of mean velocity and normal stress in an annular jet

5 — CONCLUSIONS

The following conclusions may be extracted from the preceeding text.

1 — Non-uniform spatial distributions of scattering particles can lead to errors. These errors have been quantified in a free jet flow and shown to be of the order of 5% and 10% of the centre line mean and rms values, respectively. Additional bias errors may occur in regions of high turbulence intensity and remain to be quantified precisely.

2 — An Acousto-optic cell represents a convenient instrument to allow the light-frequency shifting required in regions of near zero and negative mean velocity and high turbulence intensity. It also facilitates the removal of the low frequency signals associated with particle arrival (pedestal) and reduces the percentage bandwidth of a given signal.

3 — The two signal-processing procedures based on counting are preferable to analogue frequency analysis because of the uncertainty which arises in the latter technique from base-line noise. The counting procedure based on the computing counter requires considerably less time than that based on the frequency analyser but, for the present range of frequencies, necessitates counts based on at least 32 fringes with possible consequent imprecision.

4 — The values of mean velocity and the corresponding normal stress obtained with three signal-processing arrangements and without seeding in the region of flow downstream of a disc baffle are in close agreement and of sufficient precision for most practical purposes. The close agreement of the three sets of measurements which are subject to bias errors of different magnitudes, suggests that these bias errors are of comparatively small magnitude.

5 — The measurements indicate that the recirculation region extends to a downstream distance of approximately 1.1 baffle diamters. Negative mean velocities with magnitudes up to 10 m/s and dimensional rms fluctuations up to 5.5 m/s were observed in the recirculation region. On the centre line, the measured probability distributions were very close to Gaussian at locations in and downstream of the recirculation region. A more extensive examination of the flow is necessary to provide measurements suitable for the detailed testing of the flow situation and development of turbulence models appropriate to recirculating flows.

ACKNOWLEDGEMENT:

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Feiras, Conferências, Exposições e Congressos

OBJECTIVOS E PROGRAMA	LOCAL, DATA, ORGANIZAÇÕES E INFORMAÇÕES
Feira Internacional de Kinshasa	Kinshasa 21 de Junho 6 de Julho - 75
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4.ª Jornadas Luso-Brasileiras de Eng.ª Civil	Recife e Salvador (Brasil) 3 a 17 Agosto - 75
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La Foire Internacionale Pour la Protection des Eaux	Jönköping - Suède 1 a 4 de Setembro - 75
1.ª Internacional Conference on External ano Internal Protection of Pipes	Kingston - Upon - Hull (Inglaterra) 8 a 10 Setembro - 75
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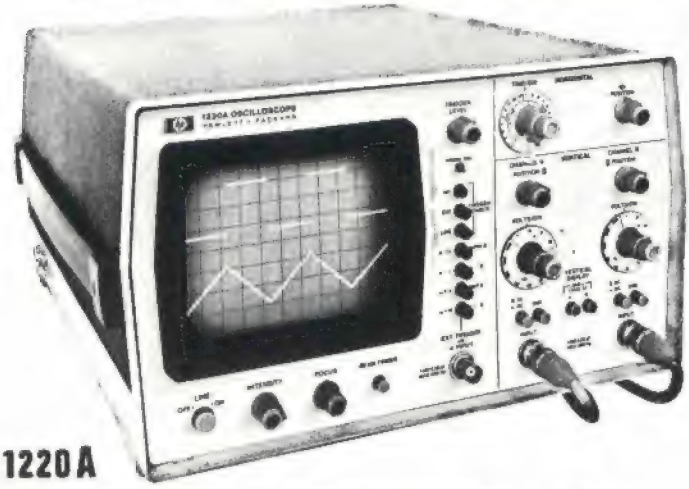

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Space and Scientific and Technological Progress (*)

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Rector of the Moscow Physico-Technical Institute

RESUMO

O autor considera a influência que as explorações espaciais tiveram sobre o progresso da Ciência e da Tecnologia, chamando a atenção para a importância crescente das ciências básicas na engenharia e para o desenvolvimento de métodos de cálculo capazes de tratar problemas extremamente complexos. Todo este progresso veio trazer novas exigências ao ensino de todos os graus, e especialmente ao ensino superior, e pôr novos meios tecnológicos à disposição da educação. Quanto a este último ponto, o autor dá especial relevo à utilização da televisão educativa em conjugação como satélites artificiais.

SUMMARY

The influence of space explorations on the progress of Science and Technology is considered in the paper. Attention is called to the increasingly higher importance of basic sciences in engineering and to the development of computing methods capable of dealing with extremely complex problems. Such progresses put new demands on all degrees of education, and especially on higher education, and also made new technological tools available to teaching. In what concerns this last point, especial emphasis is put on the use of educational television associated with artificial satelites.

SPACE SCIENTIFIC AND TECHNOLOGICAL PROGRESS GRESS

On October 4, 1957, the first artificial earth satellite was placed into orbit in the Soviet Union to mark a new era in the history of mankind. Since then space exploration projects and especially manned space flights have made a profound impact on the development of science, engineering, production, education and world outlook of the entire human society.

The past 10-15 years have seen an intensive development of a variety of scientific and engineering methods of research, with a decisive role having been played by the wide application of high-speed computers in applied research practices.

Space explorations have given a powerful impetus to the progress in a number of areas of science and technology, such as electronics, computer techonology, cybernetics, remote control, gas dynamics, magnetic hydrodynamics, applied mathematics, etc. The world is witnessing an increasing interpenetration of various fields of knowledge and the appearance of new disciplines at their interface; these include microelectronics, astrophysics, control of movement of artificial bodies, space biology, and space medicine, to mention only a few. Basic sciences such as mathematics, physics, and philosophy are penetrating deeper and deeper into the sphere of engineering and applied research.

Outer space is an inexhaustible scientific laboratory, a source of human knowledge. Over a relatively brief period of space exploration, a number of new and unexpected discoveries have been made. These include, among others, radiation belts of the Earth; studies hitherto inaccessible to observers on the ground such as the study of upper atmosphere, study of ultraviolet radiation of the Sun, study of magnetosphere, and direct studies of the Moon and planets.

The application of satellites as active or passive relays has enabled vast territories of the Earth to be covered by television broadcasting, which is of great cultural and educational significance and is promoting international exchange of cultural values. With the appearance of meteorological satellites, more correct weather forecasting has become possible, and this is of the utmost importance for aircraft and ship navigation, agriculture, and large construction projects.

The broad complex of space explorations places increasing demands on control systems, materials, and production as a whole. The appearance and vigorous growth of new areas of science and techonology has led to a considerable intensification of mental work, and this in turn has resulted in new requirements to theoretical and experimental research, viz.: high efficiency of the methods developed, the need for conducting broad complexes of research projects, etc..

Today science is becoming more and more a productive force of society. It may well be that it is outer space that has made science especially attractive for young people. Owing to its strict methods of logical thinking and to its strong arguments science disciplines society and improves its moral principles.

* O presente artigo foi entregue em Dezembro último, pelo Professor O. M. BELOTSERKOVSKII à Comissão Organizadora do 1.º Congresso Nacional de Mecânica Teórica e aplicada, durante a sua permanência em Lisboa, como conferêncista convidado a participar no referido congresso.

The Soviet Union was the first country in the world to have a State form of science organization, which permits a rational conduct of scientific and engineering projects up to their practical implementation.

SPACE AND WORLD OUTLOOK

Space explorations which have made a new epoch in the cognition of nature, have a strong impact on philosophy, supplying it with new data required for the solution of a number of ideological and methodological problems; of these problems of the utmost importance is the question of bounds of applicability of ideas and concepts of macroscopic science to cosmic objects.

Of great interest is undoubtedly the substantiation, on the basis of space studies, of the principle of material unity of the world; elucidation of relationships between laws and regularities governing the behaviour of objects of microcosm and macrocosm; possibility of division of a single matter into matter and antimatter; study of spatio-temporal metrics in terms of outer space as different from the Euclidean metrics. Favourable conditions are now created for solving the problem of possible existence of non-terrestrial forms of life and civilization, the problem of possible everlasting existence and development of human society, and so on.

The dialectics of nature and cognition appears to be such that the penetration of human thought and activity into space will make possible the solution of major problems of microcosm physics as well.

The science of today is becoming increasingly space-oriented, which cannot but tell on the development of world outlook and the evolution of the style of thinking of the present age Based on space exploration results, traditional concepts will be further reappraised and seen in a different light.

In particular, this concerns the relationships between theoretical, applied, and computing methods used in various sciences. Thus, for instance, several years ago a scientific problem was considered to be solved when a certain mathematical model to describe a given physical phenomenon had been constructed and a closed loop analytical solution of this model had been found; difficulties involved in computation were not regarded as being of great importance in principle. In contrast to this, inspace studies computing problems are so complicated that they call for the elaboration of radically new theoretical conceptions and applied methods and for qualitatively new computer technology. A similar situation exists with respect to the study of microcosm.

Thus, «cosmization» of science is not an accidental but a natural and necessary process which represents one of the facets of present-day scientific and technological revolution.

The increased role played by computing mathematics has a substantial bearing on the structre of modern education. Thus, new methods for personnel training are devised; also, differences between the theorist, experimenter, enginner, and scientist are now seen in a different light.

As the elements of geocentrism are being overcome, the system if theoretical knowledge itself becomes also transformed. This process proceeds at least in two directions: first, the validity of laws discovered on the Earth are verified under conditions of outer space; and, second, space studies result in the discoveries of new laws and regularities. New interpretations are given to many scientific concepts. This cannot of course but tell on the contents of curricula, lectures, and laboratory work in educational establishments.

The new information incorporated in the curriculum greatly increases the interest of students in science, arouses their curiosity and vividly demonstrates the cognoscibility of the world. Thus «cosmization» has a bearing on such fundamental problems of philosophy as the knowability and unity of the world, bounds of applicability of concepts, and prospects for the development of society.

«Cosmization» of science is a complex problem whose solution calls for the integration of sciences and for specialists with an all-round education united in large collectives. Within the system of scientific education, the role of logical links between the individual sciences is increasing, and the need arises to get people accustomed to collective scientific work and develop a sense of scientific fellow feeling.

Thus, space research and exploration, which mark a new era in the development of natural sciences, have a profound and beneficial effect on the modern world outlook, on the system and pattern of thinking, and on the content and form of general and specialized education.

SPACE EXPLORATIONS AND EDUCATION

The ever expanding scientific and technical research necessitates a great inflow of trained young specialists. Accordingly, new institutes, departments, and specialties are being established. The demand for researchers was so great that the system of specialist raining in higher and secondary general and specialized educational institutions had to be radically changed to make it more flexible and capable of graduating, within sufficiently short periods of time, the required number of specialists in new areas of science and technology(the first requirement to present-day education).

Further, problems associated with space exploration, have posed very complex scientific and engineering tasks before all categories of specialists. Thus, for example, engineers and scientists dealing with aerodynamics are now faced with a whole series of completely novel problems involving the determination of aerodynamic characteristics (a field of study with which the present author is directly concerned). This necessitated the elaboration of new methods and approaches. These include investigations in a wide range of flight velocities from trans-sonic flows to hypersonic flows, also, characteristics of viscous fluids have to be studied. This necessitates taking into consideration various physico-chemical transformations of the gas, and phenomena of dissocia-

tion and radiation, as well as studying most diverse forms of spacecraft and rocket stages. Purely scientific tasks (usually associated with the statement and solution of complex nonlinear problems of physical gas dynamics) are intimately interwoven with applied problems (development and application of efficient methods for the solution of problems involved), engineering problems (finding optimal solutions from the viewpoint of the system as a whole, using the information obtained in theoretical and experimental studies), and also problems of purely industrial character, involving implementation of the project at hand.

All this has resulted in the need for a new type of researcher who combines a profound theoretical and broad engineering training and who is capable of solving complicated scientific and technical problems(the second requirement to present-day education).

At this day age of scientific and technological revolution, the requirements placed by industry to education have greatly increased. Yet these increased requirements should not interfere with the general purpose of education, that of providing for an all-round development of human personality.

In the Soviet Union there are two main types of institutions to train personnel with a higher education — universities and technical schools. The first of these train specialists with a broad scientific background which, however are not specifically prepared for work in industrial research institutes and laboraties; the technical school, on the other hand, does not provide specialists with sufficient general education. There is now a definite tendency toward ironing out differences between university and technical education. Also, an increasing role is played by industrial technologists and, especially, by scientists-organizers capable of heading large collectives of scientists and of bringing together the points of view of scientists and technicians and engineers.

Now there arises the most difficult question, that of how to fulfil in practice the above requirements to education.

In training specialists of high professional qualification (research engineers, applied scientists) in rapidly developing branches of sciene and technology (including the field of space exploration), it is necessary that such basic subjects as mathematics, general and theoretical physics, philosophy, foreign languages, and some other subjects should be studied according to the curriculum adopted at universities, so that the future specialists could have an active knowledge of the above subjects which form the basis of general education of the research engineer. Great attention should also be devoted to the study of applied, practical aspects of the above courses (laboratory work, compilation of abstracts, etc.).

The main objective of such an education consists in the acquisition of profound knowledge in basic disciplines and the development of creative thinking in the students. It is important that the completeness of the courses in basic sciences did not prevail over the ideological and creative aspects of education (in this we see the difference between instruction and education).

Specialization (the second cycle of education) should be initiated by reading courses and conducting laboratory work in broader subjects. Thus, it seems reasonable, for example, to unite the course of hydrodynamics and of elasticity theory in a single subject the «mechanics of continua» and to present the various aspects and trends of this discipline from a single viewpoint.

Training in a given speciality should of course be conducted in well equipped laboratories or research institutes. It is important that instruction at this stage be given by specialists actively working in a given field.

One of the prerequisites in the training of a research engineer is his enlistment into active independent research work starting from the third year of study.

The tasks facing secondary general and specialized education are determined by the requirements of the higher school, on the one hand, and by the demand for intermediate personnel, on the other. The scientific and technological revolution has altered curricula of secondary technical schools as well. Thus, according to the newly adopted curriculum pupils of senior classes of secondary schools will have, in addition to 30 hours of compulsory lessons, cycles of optional courses, based, as much as this is possible, on the principle «learning is an act of discovery». In each case the selection of the optional course is a matter to be decided by pupils themselves.

Not only in large cities, but in small towns and villages as well, young people, including secondary school pupils, are showing an increasing interest in physics, mathematics, and technical sciences, an interest which has been greatly promoted by space exploration efforts. Accordingly, these subjects are now given greater emphasis in school curricula. In secondary schools, there are now many rocket modelling circles. This stimulates the interest of young people in the study of electronics, mechanics, and designing. At present even international competitions are sometimes arranged among amateur rocket modelists.

As a result of radical changes introduced owing to achievements scored by space exploration projects, a need has arisen for establishing, in educational establishments, of new specialities and departments (space physics, celestial mechanics, remote control, etc.) and for reviewing the curricula of general education courses.

So, one of the most significant contributions of space exploration in the sphere of education is, as it should be admitted, ever widening interest which is awakening among different categories of people (and especially among the youth) to science, technology, knowledge.

Investigation of space in not only a scientific and technological process resulting in storing new data, but it also deeply influences all the levels of general and special education. New requirements and stimuli for education system perfection spring up; differences between technical and university types of education are observed to gradually disappear; traditionally remote specialities find ways for merging; interest to science, technology, knowledge is growing.

A considerable place in the process of increasing the level of education is occupied by television. The

communication sputnics when used in the interests of educational television programms open enormous prospects.

TELEVISION, SPUTNICS AND EDUCATION

In the light of the abovesaid the «field of activity» of the educational television is now growing manifestly.

What are the possibilities here?

Among others we consider to be of great importance first: systematic propaganda, through TV programs, of the studying of fundamental sciences in different branches of knowledge; these programs should offer thoroughly worked out and well organized courses of lectures, seminars, and discussions for various groups of TV audience — from schoolchildren up to specialists.

Second, TV education is practically vital for these who desire to increase their professional knowledge. Hence, systematic propaganda of the achievements in speedily developing branches of science and technology such as electronics, radio techniques, computational mathematics and modern sections of physics is on the agenda. We want to hope that in future television will occupy in our country a proper place and will as well play a leading role in the correspondence courses, just as we see it in, for example, Japan and in other countries.

It is of great important that the lecturer should have «his own» audience, have a constant contact with its members; this contact might take the form of: personal or correspondence conferences; meetings; a TV «student» (probably previously some way or other admitted or registered) must be granted the possibility to receive, for a reasonable price, a printed text of the lecture or a consultation and so on. To attend a closer mutual psychological contact of the lecturer and the audience it seems expedient while organizing such TV lectures to have in the studio a small group of students who could ask questions to clarify certain points and so like.

The problem of «your own» audience and of the «feed-back» contact is, as we believe, a decisive factor in TV training. It is naturally not possible to rely only on the desire; we know that a real education process requires a very firm self-discipline!

And, at last, third, we see it expedient to devote much more attention to the problems of experimental training of school children and students in the educational programs, because the needs and possibilities of television in this field are rather great. Of late in our country a lack of high qualification physisists-experimenters and physicists-designers is constantly felt and to stimulate the interest of the youth in these directions is to our mind of importance.

The majority of the specialized schools, circles, and sections are devoted to theoretical problems (as a rule, of mathematics) while a physical study or a physical laboratory is still a weak point in many secondary and technical schools. TV olimpiades and TV laboratories in the field of developing practical command of experiment in the most diverse directions and for various categories of the youth training are necessary.

A TV set seeks for a place in the high school itself. But it is more than obvious that under even the most rosy optimism no TV-set can substitute for a personal contact and a psychological effect of an expert and experienced lecturer on the audience. A TV-set is not a competitor to a good teacher, it can but be his assistant. As such it opens great opportunities in demonstations of subtle experiments, in repeated lectures (especially for part-time students) and so on.

The experimental results on internal TV programs in an institute which are used to control and organize the very training process deserve attention. But here we again must distinguish between necessity and possibility, add to it that every step here costs rather high.

Now we shall discuss a very interesting practice of educational TV programs organization in the Soviet Union. The Central Television has initiated these programs since 1974.

Nowadays the Chief Editorial Board of the popular--science and educational programs, which was organized in 1970, prepares both educational and popular-science programs. The majority of the topics are broadcast through the channel 8, program III, but nevertheless they now firmly appear in the frame of the programs I, II and III, as well as in the «Vostoh» and «Orbita» programs. The Chief Editorial Board invites the leading scientists, writers and people of art of our country to take part in these programs.

Programs I and III dayly give a one hour educational item, and the «Vostok» and «Orbita» programs, in addition to the above two, included in their permanent plans such items: «The problems of national economy perfection on the basis of implementation of economico-mathematical methods and computers» and «popular TV University».

A considerable part of the TV programs is intended for the secondary school children and is planned by cycles practically for all the forms from the second to the tenth on the following subjects: social science, history, physics, chemistry, geography, biology, natural history, zoology, literature and music. The morning TV items are meant for class work during a lesson, their starting time being coordinated with the schools time--table. So TV programs become a part of the training process. The evening TV items are intended for home work, their scope goes far beyond the limits of the school material, and they are aimed at extending the pupils horizon.

Those who are preparing for the enterance examinations to the institutes can «attend» lessons on mathematics, physics, Russian and foreign (English, German and French) languages. The material of such lessons on physics and mathematics cover almost all the school program in these subjects and they are worked out taking into consideration the requirements at the enterance examinations.

A considerable par of the time of the Editorial Board is devoted to the 1-st - 3-d course part-time students, mostly organized in groups under the system

of the All-Union Politechnical Correspondence Institute and a member of other Correspondence and part-time Institutes. This activity includes cycles on such technical subjects as: physics, higher mathematics, discriptive geometry, general chemistry, theoretical mechanics, and strength of materials.

The programs for specialists have the aim of extending the practical qualification and the specific knowledge of the latters. There are special weekly items over the 1-st and the 3-d programs designed for the administrative personnel of the ministries, departments, enterprises and offices.

Under the heading «Screen to doctor» the organized training is carried out in the sphere of different branches of medicine for the physicians of different specializations. For teachers the «Screen to teacher» gives cycles on the methods of representation of certain problems and topics in relation to the transition to the new secondary school programs. Some items are on TV for the specialists of various spheres of the national economy.

A considerable experience on educational TV implementation in the field of retraining specialists as well as in the perfecting the whole system of education is obtained in the United States. Many experts and special comissions think that in the process of education there exists a necessity of wide introduction of the modern technology including television, of consolidation of all the pedogogical and material resourses of all the national educational centers with the help of an automatically controlled communication system employing Earth artificial sputnics (EAS) and ground communication systems.

In the USA experiments had been carried out on the TV training of the specialists within the frames of some Universities. The aim was to retrain the technical specialists working within the 40-50 mile radius from the University center.

There exist several principally different aspects of the organization of the educational TV programs in the USA. They were organized along the following systems:

— perfect two-way television;

— one-way television and two-way radio;

— «blackboard» by wire;

— telephone-line communication.

The first system — perfect two-way television — can be used in a remote training system if there exist special local classrooms which are equipped with corresponding devices to contact with the head University. The requirement is — the instructor and the student both see and hear each other. In special cases the network was used for oral examinations and consultations.

The technical education television system called GENESYS which provided a one-way television and a two-way radio communication was used in the Florida University. The network covering about 200 square miles consisted of four transceivers connected to there receivers.

Many American Universities widely use the «blackboard by wire» system. The main idea is operating in such a way: the professor writes on a table with a specially processed upper surface and the picture from this table is represented at a distance in the rooms-receptors.

A two-way telephone line can be used in the cases when the records of the lecture or a videotape are sent to the receiving point in advance. A modification of this system permits a posted videotape with an open acoustic line. Some other variants of the television implementation in the training process are not excluded.

Thus, television — one of the most «visual» achievements of the research and technology process — has become an integral part of our life. We see that now as yet it turns to become an important instrument of training, but being added by space means it can play a determinant role. In fact, the areas of our globe which are most hungry for teacher are not, as a rule, covered by a ground television network. Sputnics can open the doors to the best lecture halls of the world for the like areas. The very idea of the television in the training process is not new. A number of investigations in the field of education with the help of television demonstrates the fact, that the main part of the subjects the sttudents can learn using TV training programs almost so well as having direct contacts with an instructor.

Let us now dwell upon the problems of the televising via communication sputnics over vast territories of our planet for mass education of people. In the sphere of mass education development one of the pressing problems facing now society (especially in the developing countries) is the lack of high quality teachers for secondary and higher education systems. Artificial sputnics of the Earth open here new possibilities and prospects. It seems to us that the cardinal solution of the problem of mass education in the future will be found in the form of TV education of people with the aid of the communication sputnics.

At the sessions of the International Astronautic Federation, at the UN conference on the research and use of the space in the peaceful purposes which was held in Vienna in the summer of 1968, in many reports different technical, political and social-economic aspects of this form of training were discussed. The opinion of the majority of the specialists was unanimous: direct radio and TV programs via sputnics will render inestimable aid to the developing countries, to the population of difficult areas in solving such problems as: illiteracy liquidation and extending educational qualification among children and adults; research into the foundations of the rational agriculture to develop its productivity and to control famine; creation of a common language within a country (India, Nigeria). The industrial countries can more actively use such programs for further development of the education system, for extending the network of the correspondence training, and for the retraining of the engineers and technical specialists and so on.

However, televising over large territories of the Earth which cover several states or at least regions speaking different languages, will involve besides technical linguistical and law proglems.

In principle there might be suggested two ways of solving this problem. For primary education the programs are proposed to be organized in such a way that the images or pictures would not ask for any explanation

or the explanations would take a form of minimum length texts. Here some methodological difficulties will appear and for a number of countries of a considerable interest will turn to be the progress in the direction of the development of such a methodology attained within UNESCO. The second way looks like this — to give the language accompaniment of the images through several channels in translation into corresponding languages (in the International Union of Electro-communication there exists a program. designed to solve this problems).

To sum all up, the problem of educational televising via communication sputnics over large territories of the Earth embraces the following aspects:

1 — creation and realization of an engineering project;

2 — problems connected with the program to be televised (linguistical problem, preservation of the national traditions in education, problems of idiology);

3 — organization of the «feed-back».

In synchronious equatorial sputnic we see a most convenient instrument for televising programs of general education. Such a sputnic which will be constantly in the field of vision of a given longitudinal belt would give the possibility to use low cost fixed antennae for a direct receiving of radio and TV programs by even the remotest countriside schools. Now there exists a technologic possibility to mount powerfull but rather light sun battaries on the sputnics which are necessary to ensure direct televising programs in the schools that have small receiving antennae.

The main problem in the development of the educational television is, as we see it, organization of a dialogue between a teacher and a student which requires the creation of a two-way communication system. The cable television as a part of a TV complex embracing local TV centers, radio relay and cable communication lines with the community and individual users seems attractive. On the scales of a nation and an international cooperation communication can be organized through main radiorelay lines and communication sputnics by means of which inputs of the local TV complexes can be connected.

For better organization of contacts of the students — users with the lecturer to establish an operative control of he students mastering the program it might be fruitfull to use a computer to process the answers to the questions. Thus, one cable line can provide up to 40 TV channels. Practically realized cable TV systems have 20. Cable lines do not radiate electromagnetic energy and offer high reliability. That is why a branching cable distributing network can be created to transmit information to and from a student-user.

PROGRAMS OF THE PRESENT AND THE FUTURE

Withein the last years educational programs transmitted via the artificial sputnics of the Earth (ASE) became ever more important despite high expenditures connected with their launches. The growth of these expenditures is due to the highcost additional equipment needed (say videomagnetophones and so on), but the growing scope of the programs will though partially counter balance this raise in prices.

We cite here some data published last year.*

In the USA they intend to use seven synchronious ASE for the educational television system, to ensure its operation. The territory of the USA is planned to be divided into 15 regions. Each of them will receive seven channels with 40 Mcps bandwidth, which will mean one TV channel per State. All the schools will have feedback lines via ASE (bandwidth 2 Mcps) with the regional education center. As the communication center would require the total bandwidth of 2.3 Gcps for the communication line «ground station — ASE» it is suggested to use a range of 30 Gcps, and for the reverse direction — 18 Gcps range. To receive the programs in schools parabolic antenne with 1.2 m diameter, and with the width of a directional diagram 1 and 0.6° on the frequencies of 18 and 30 Gcps accordingly.

On the groud station 100 w transmitters are planned; to feed one channel a transmitter-retranslator would require 150 power supply. To extend retranslators reliability each channel will be added a reserve amplifier.

To televise the educational programs via ASE over the Latin America countries the Telespazio firm (Italy) developed a project of a system which foresees construction of 100 thousand training centers to receive the programs for 200 milion students. Each center will be equipped with receivers and parabolic antennae and will be located in a one-storey building of two-three classes. Two ASE will be used in the system, each will board a 1 K. W. transmitter. Three antennae of an ASE will service three zones by a simultaneous televising two programs to each zone. Two ASEs will ensure simultaneous operation of 12 channels.

Stanford University (USA) specialists developed a microwave system to receive the educational programs from the sputnics on the territories of Brazil and India. The system includes a 2 meter in diameter parabolic antenna, a mixer unit, oscillator, an intermediate frequency amplifier, an FM detector and a transducer, the receiver is designed for 2.5 Gcps frequency and the band of 25 Mcps, the price will be about 150 S/. For a stable reception of the programs over Brazil the sputnic-borne transmitter is needed to have about 300 w power, while to cover India only 160 w.

In 1970 the USA network to educational television embraced up to 8 million people. This network consisted of the national educational TV net (NET), public broadcasting laboratory (PBL) and others. It expected that by 1980 educational television will cover the same number of regions as the commercial one.

Japanese specialists propose not only to use the decimeter range to watch the educational programs

* Radioelectronics in 1972, vol. II, N V, 1972.

(transmitted without cable aids) but also to use new portable systems operating in the microwave range. The Toshiba company developed to this end a system consisting of transmitting and recieving devices operating in the 11 Gcps range. Sharply directional antenna permits to deminish the transmitter power to 100 MW and the power supply to 45 W.

In the Federal Republic of Germany where there exists a chronic lack of expert teachers, the demand for radioelectronic audiovisual apparatus has grown. A number of big companies including Siemens and BASF ones attempt to meet this demand producing new items. In 1971 the BASF developed and planned for production systems BASF-2800, BASF-3400, and BASF-5600 designed to reproduce educational programs. In the systems special cassettes with the endless «Super-8» tape and minicassettes to reproduce sound are used. The Siemens developed as well an educational television system designed to be used in combination with a computer which is intended to operate on the free choice of the answer principle.

The most interesting projects are the closed systems of television introduced there, where the education authorities have under their control a considerably big number of the education units. The biggest of such systems, operative in London, embraces 1000 schools and 130 colleges and institutes. The programs are transmittable by cable from the central studio to any schools of the city region where they are needed. The like systems are or will be introduced in Glasgow, Cambridge, Hull, and Plymouth.

But in Britain they still are sticking to the traditional equipment. According to the specialists from the Rank Audio Visnal company the market will be mainly dealing with audio and television systems, because modern radioelectronic complexes with feed-back and computers are unacceptable in the interest of elementary education.

By now in the Soviet Union there is a rich experience on televising via the communication sputnics. In october 1967 a network of the «Orbita» stations was put into operation. These stations are used to receive and retransmit at certain TV centers the programs of the Central Television broadcast by means of the «Molnija-1» communication sputnic. This permitted us in a short period of time to cover all the country by TV field, the sputnics shortening by 10-15 years the day of television penetration into the thinly populated regions. Television quickly spread over the remotest regions of the Far East, Deep North, and the Middle Asia such as: Vladivosto, the Sakhalin, the Kamchatka, Archangel, Magadan, Yakutsk, Vorkuta, Frunze, Ulhan-Ude. By the present time the Central Television program became the all-Union one.

The radio communication system via ASF of the «Molnija-1» type (launched in April 1965) provides retranslation of one monochrome or one polychrome TV program, a number of telephone communication channels and other types of communication. The system was developed on the data on the geographical location of the USSR. In the solution of the problem of radio illumination of the USSR territory the most prospective, at the first glance, radiocommunication systems with the so-called syncronious sputnics of the Earth do display certain disadvantages. The orbit of such a sputnic must be placed on the equatorial plane of the Earth at the altitude of about 36 thousand kilometers only in this case the sputinc will be hanging over a fixed point of the globe. But the territories beyond the latitude 30° North would turn to get in the area of the shade. That ins why in the USSR for the creation of the sputnic systems of radio communication of the first stage, elliptical orbit was chosen.

In the «Molniya-1» sputnic field of vision on the odd turns Asia, Europe, and the North-East part of Africa will be displayed. On the even turns in this field of vision enter the western part of the USSR territory, Europe, part of the USA and Canada territories. The duration of the communications between he points in this zone is 6-8 hours a day. TV programs are directed along the radiorelay lines to the space communication centers, and then to the sputnic, the hardwear operating in the centimeter range.

In 1971 and in April 1973 the Soviet Union launched to a high elliptical orbit new communication sputnics «Molniya-2» with space-borne retranslation units operating with the system in the centimeter range. The «Molniya-2» is designed to secure the operation of the system of distant telephone-telegraph radiocommunication in the Soviet Union, to transmit Central Television of the USSR programs to the «Orbita» network nods.

The «Orbita» TV receiving net which operates in link with the «Molniya-1», now has about 40 receiving stations. Using this net it is possible to operatively create a distribution system to relay the TV programs to great distances to the local TV centers and retranslation stations.

The «Orbita» net is being further developed and modernized nowadays. The number of the local colour TV receiving stations is growing. Research and development is underway in the direction of extending the zones of the stable reception of the programs. Perfection of the receivers and transmitters includes deminishing the eigen noises of the reciever by using parametric amplifiers the first stages of which are Helium-vapor cooled. The power increase of the space-borne transmitters opens the way to simplification in the ground sets which would permit in the nearest future to receive TV programs from communication sputnics directly on the private TV sets. At the same time the quality of the images will increase because multireflected signals would disappear, which is of especial benefit in the mountains and big cities. These activities are over in our country would not be left the points where one will not be able to enjoy television (nowaday television covers the territory homing 70% of the population of our country).

The network of ground radiorelay lines enables to create a single network of educational TV. Most of TV centers become connected withe each other. Thus, Vladivostok programs are at present received by the Moscow TV center and are broadcast on the «Orbita» program over the whole territory of the Soviet Union.

Program — III of the Central TV is, essentially, an

educational one. The number of local TV centers capable of rebroadcasting this programs is rapidly growing. Multiprogram TV centers are being built in Minsk, Tashkent, Tbilisi. The communication via sputnics has considerably widened the possibilities of broadcasting radio and TV programs and is an essential constitutive link for the creation of a Single Automatic Communication System in our country.

Great prospects for international coorperation are opened by the International System and Organization of Space Communications-so-called «Intersputnic» created recently for providing its creators with telephone and telegraph communications, for exchanging radio- and TV programs as well as for other kinds of information via transmitting ASE.*

The agreement connected with the organization of «Intersputnic» was signed in Moscow, November 15, 1971, by the representatives of the goverments of Bulgaria, Hungary, GDR, Cuba MPR, Poland, Rumania, USSR and Chekoslovakia. The agreement is based on a resolution of the UN General Assembly on the principles of the activity of countries in the exploration and utilization of space including the Moon and other heavenly bodies. «Intersputnic» is an open international organization. Any country whose government has signed or joined the agreement may become its member.

This system comprises a space complex consisting of communication sputnics and ground guidance systems responsible for reliable functioning of sputnics and ground stations connected with each other via sputnics. This space complex may be the property of the organization or can be leased from a member-country. The ground stations are to be built by member- countries on their own territories with their own money according to universal technical requirements.

Sputnic systems for direct TV broadcasting (DTB) by means of individual and collective antennae may become one of the promising directions in creating TV educational systems. The application of stationary sputnics for rebroadcasting programs may appear most convenient for this purpose since antenna arrangements become unnecessary in this case. The modern level of space technology makes possible the implementation of the DTB system. With the help of 3 sputnics launched on a stationark orbit this system allows us to broadcast TV programs over a major part of the Earth including programs for educational and professional training.

For the implementation of DTB system the working group of the UN commission on peaceful utilization of space recommends using the frequency range of about 800 Mcps. For this purpose TV-sets are to be supplied with an appropriate device — a converter

The transmitter power of a retranslator may vary in the range 0.63-54kw depending upon the width of the directional diagram. As is in ground TV broadcasting, provision is made that a video transmitter be amplitude modulated and an audio transmitter be frequency modulated. The sputnic weight with a transmitter power of 2kw will amount to approximately 750 kg, with a power of 13 kw — not less than 3 tn.

For a practical implementation of the DTB system a lot of law and organization problems is to be solved on an international scale along with overcoming many difficulties of a technical character, e. g. connected with the necessity of developing highly reliable and powerful retranslators. The point is that the DTB system cannot be a prerogative of once or even several countries. Its realization by means of sputnics necessitates a mutual multilateral cooperation on questions of technical criteria and, in particular, on questions of the distribution of frequencies and sputnics in the near Earth space. A mutual bilateral and multilateral cooperation on questions of the protection of authorship is necessary for broadcasting TV programs via sputnics.

TV broadcasting itself mus be realized on the basis of universally adopted principles of international laws including the UN statutes as well as the agreement January 27, 1967, on the principles of the activity of countries in the exploration and utilization of space.

The realization of the DTB system for the people of foreign countries wholly depends on a consent of these countries. The cooperation among countries may become possible only on the basis of a strict fulfilment of the principles of the sovereignty, peaceful coexistence, equality of rights, mutual benefit and respect for he interests of each country.

In short, the DTB system ought to contribute to an increase of an educational level of the population, cultural progress, an extension of international exchange in the fields of science, culture and sports.

Broadcasting advertisement and commercial programs may be realized only in terms of agreements specially concluded between interested parties on a certain question.

TV programs broadcast by the DTB system must not deal with war propaganda, militarism, nazism, national and racial hatred. The materials of amoral and insinuating character as well as interference in the internal affaairs of other countries or their foreign policy must also be excluded from such programs.

Programs for the population of foreign countries if they are broadcast without an explicitly expressed consent of the governments of these countries as well as programs concluded on the basis of agreements which do not meet the requirements of clause 102 of the UN statutes are classified as an act of piracy and may be interrupted by any accessible means.

At present, there is under way a project of the Convention concerning the principles of the utilization by countries of ASE for direct TV. Broadcasting which will promote international cooperation in the practical implementation of the DTB system via sputnics. The Convention provides for the elaboration of law aspects for the creation and utilization of the DTB system.

The experience in space expoloration once more comfirms the idea that a genuinely scientific contribution gradually becomes the property of the whole community, strengthens international contacts, promotes friendship among people. One might hope that he utilization of communication sputnics for educational purposes will result in unprecedented progress in the sphere of education in the next decade. Wide horizons open here for international cooperation, for consolidating efforts of all the countries all over the world.

* I. Ya. Petrov. «Intersputnic». — «Novoe Vremya», 1972, N 2.

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- Funcionamento silencioso
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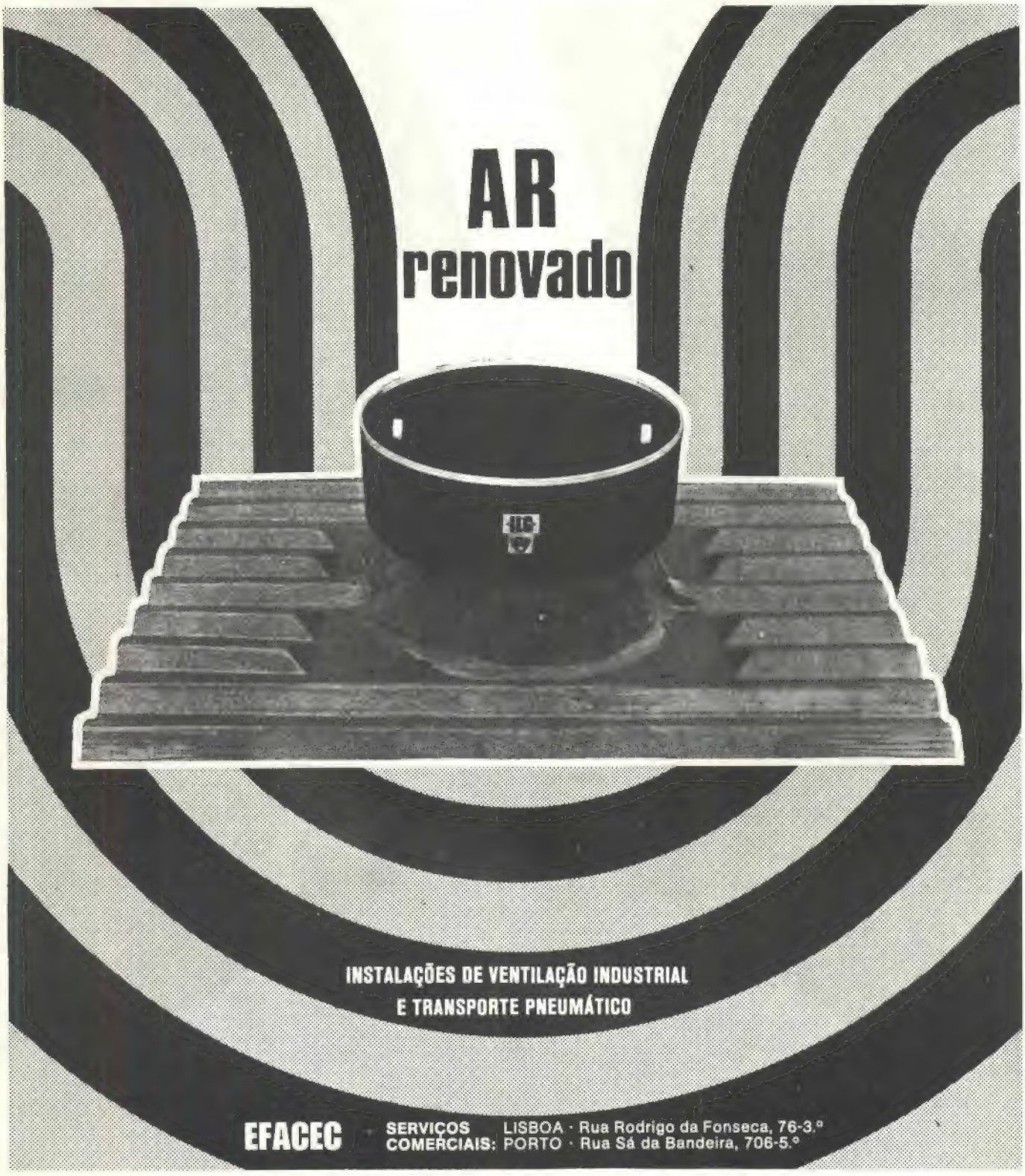

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50 anos dos cambiadores de calor aplacas APV tipo paraflow

Novas aplicações e vantagens na hidrometalurgia

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Embora o Combiador de Calor a Placas Paraflow da APV tenha criado há 50 anos para a pasteurização de leite e seja agora utilizado por mais de 95 por cento de todas as companhias de lacticínios britânicas, assim como por milhares de organizações estrangeiras, aumentou rapidamente o seu uso em outras indústrias. Resolve muitos problemas que não podem ser solucionados economicamente por outros tipos de permutadores térmicos.

No domínio da metalurgia, por exemplo, um Cambiador de Calor Paraflow montado nas instalações de preparação industrial de uma companhia mineira da América do Sul foi substituir 14 termo-permutadores tubulares. E isto porque o fluido supersaturado que é submetido ao tratamento térmico nos permutadores tubulares passa através dos tubos a uma volocidade relativamente lenta e permite que se formem cristais nas superfícies dos tubos. O fluido percorre com tanta rapidez as unidades Paraflow, com o seu funcionamento mais eficiente, que não há tempo para se produzir cristalização.

Nas instalações industriais de Bosveld Kunsmis, na África do Sul, são utilizadas duas unidades equipadas com placas de Incoloy 825 para arrefecer uma solução de ácido sulfúrico de 69° C para 34° C à razão de 6.500 litros por minuto, empregando àgua de refrigeração à temperatura de 27° C. Neste caso, a utilização economica daquele liga relativamente dispendiosa pelas unidades Paraflow foi responsável em grande parte pela escolha desses permutadores térmicos.

Os cambiadores de calor e placas são utilizados muitas vezes no processo químico pelo qual a alumina é extraída da bauxita. Depois da bauxita ter sido tratada com soda cáustica para a extração da parte útil do minério e após tratamento de preparação adicionais, a solução restante é arrefecida de 95° C para cerca de 45-50° C antes de ser transferida para um recipiente no qual a alumina é cristalizada. O agente refrigerante é uma solução cáustica fria (contendo vestígios de alumina) do recipiente de cristalização, que tem que ser aquecida antes de voltar ao início do processo.

Vinte e quatro tipos diferentes

Hoje, após 50 anos de desenvolvimento contínuo, milhares dos 24 tipos diferentes do Cambiador de Calor industrial Paraflow encontram-se em funcionamento em, pelo menos 60 países de todo o mundo. Estas unidades funcionam com mais de 200 substâncias diferentes, tais como o ácido sulfúrico, emulsões de ceras espessas, óleos vegetais e minerais, e resinas de poliester. E existem ainda muitas aplicações relativamente novas nas quais os cambiadores de calor Paraflow podem ser utilizados com grandes vantagens, assim como certos setores da preparação industrial em que a totalidade das suas vantagens técnicas e económicas não foi ainda completamente reconhecida.

Basicamente, o Cambiador de Calor Paraflow da APV consiste numa armação de aço que compreende

uma placa terminal fixa, ou «cabeça», e uma base, ou «apoio terminal» ligadas por uma barra superior e uma barra inferior, e um prato de fixação móvel conhecido pelo nome de «transmissor»; este último está suspenso na barra superior e é conduzido pela barra inferior.

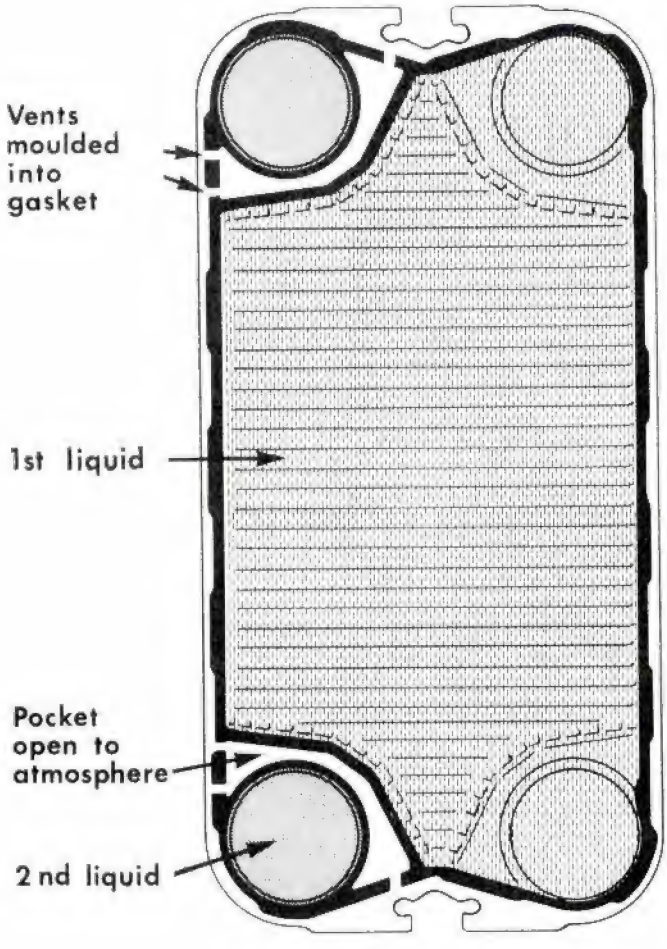

Diagram 1

Suspenso e conduzido pelas mesmas barras está também o conjunto de placas de transmissão térmica, cujas arestas estão equipadas com juntas vedantes, ficando o conjunto de placas firmemente fixado entre a «cabeça» e o «transmissor» quando a unidade se encontra em funcionamento.

Cada uma das placas tem um máximo de quatro furos ou orifícios, um em cada canto da placa. A junta tem uma forma tal que envolve completamente dois orifícios, um no topo e o outro no fundo da placa, enquanto os outros dois orifícios não dispõem de juntas em torno das suas arestas interiores. A disposição das placas é do modo a que os furos com e sem juntas se alternem em todo o grupo de placas.

Com esta disposição, os dois fluidos entre os quais vai ser efectuada a permutação térmica são encaminhados para espaços alternados entre as placas. O líquido utilizado no processo industrial e o agente aquecedor ou refrigerador entram na unidade através de ligações com flange na «cabeça» e no «transmissor», correndo o líquido do processo industrial numa direcção através de espaços alternados entre as placas, enquanto o agente aquecedor ou refrigerador corre na direcção oposta através dos espaços intermediários. As placas, separadas por intervalos muito reduzidos, têm pregas ou ondulações prensadas nas suas superfícies, as quais originam turbulência particularmente rápida e impede que se depositem sobre as superfícies das placas as matérias sólidas em suspensão.

Na zona dos orifícios, as juntas criam um espaço de ar duplamente vedado entre os fluxos dos líquidos, impossibilitando que o líquido do processo industrial se misture com o agente aquecedor ou refrigerador. Nos espaços de ar existem furos de escoamento que, nas raras ocasiões em que se avaria uma das juntas, fazem com que qualquer derrame se torne imediatamente visível.

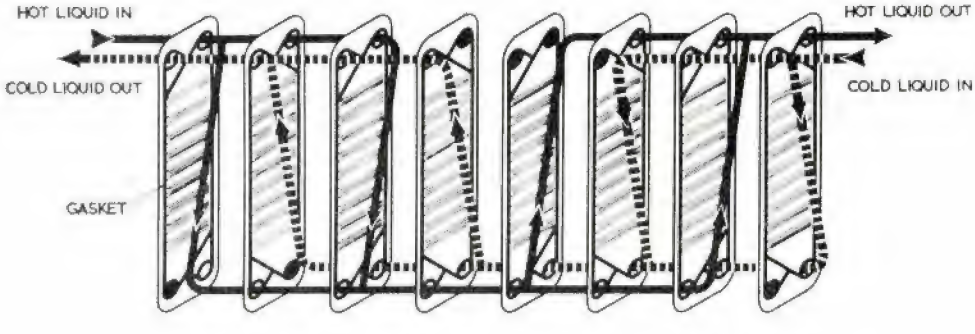

Diagram 2.

Além de originarem um índice muito elevado de transmissão térmica, as placas muito juntas oferecem uma superfície de transferência de calor de grande extensão num volume de armação relativamente pequeno. Isto significa que o equipamento ocupa muito pouco espaço. A turbulência causada pelas ondulações nas superfícies das placas contribui para manter em suspensão as matérias sólidas, reduzindo assim a acúmulo de resíduos nas placas quando estão sendo tratadas emulsões químicas ou soluções que cristalizam. Quando o depósito de resíduos é inevitável, como pode acontecer com certos líquidos, o acesso para a limpeza é muito simples. Depois de solto um jogo de placas, cada um delas pode ser examinada individualmente e, sempre que for necessário, retirada sem remover as outras placas. Este tipo de construção permite também ampliar a superfície de transferência térmica, adicionando simplesmente novas placas até se atingir um número limite para cada tipo particular de unidade.

As unidades Paraflow pesam muito menos do que outros tipos de termo-permutadores construídos para funções semelhantes e, por isso, não requerem alicerces de apoio dispendiosos. Só as arestas das placas se encontram expostas à atmosfera, e assim as perdas de calor são pequenas e não é necessário isolamento térmico. Por conseguinte, é evidente que os custos de instalação são mais baixos do que os de outros tipos de permutadores térmicos, e que a possibilidade de ampliações futuras sem ser necessária a substituição da unidade original pode ser considerada muitas vezes.

Todas as unidades Paraflow são construídas com componentes de dimensões padronizadas, os quais são intermutáveis.

Adaptáveis a funções diferentes

Qualquer modelo Paraflow pode ser adaptado a diferentes funções simplesmente por meio de uma nova disposição das suas placas. As placas podem ser fabricadas com aço inoxidável, titânio, Incoloy, metal Monel, níquel Hastelloy, Inconel, tântalo, ligas Kunifer, latão de alumínio e várias ligas com base no cobre. Normalmente, os preços das unidades Paraflow comparam-se favoravelmente com os dos termo-permutadores de tipo tubular ou de couraça; e quando se tornam necessários materiais anticorrosivos dispendiosos, os modelos Paraflow podem ser muito mais baratos. Uma vez que a transmissão do calor se efectua com tanta rapidez nas unidades Paraflow, onde requer uma área superficial menor do que outros tipos de permutador térmico, é muito reduzida, por conseguinte, a quantidade de materiais de construção de custo elevado.

Todas as unidades da série Paraflow têm como base uma das dez dimensões de placas, e o seu tamanho varia entre modelo Junior e a nova unidade R145, que se destina a utilização industrial em grande escala e tem uma velocidade de passagem nominal máxima de 955 m^3, ou de quase 1 milhão de litros por hora. O pequeno modelo junior, cuja capacidade máxima é de cerca de 2.300 litros por hora, é especialmente apropriado para processos de produção em pequena escala, ou para trabalhos laboratoriais de avaliação, pesquisa e ensaios. Pode ser instalado no assoalho, numa banca ou numa parede.

O modelo R145, apresentado no mercado em Abril de 1973, é fabricado em quatro tamanhos diferentes. O maior pode conter um limite máximo de 400 placas fabricadas em aço inoxidável, titânico comercialmente puro e outras ligadas metálicas seleccionadas. Para permitir uma economia máxima de materiais dispendiosos, a espessura normal das placas é de 0,6 mm apenas, e para assegurar a rigidez necessária para fins de manipulação as bordas das placas têm abas em flange.

As placas estão fixadas entre si por meio de catorze parafusos de aço inoxidável. Existem quatro comprimentos padronizados destes parafusos, dependendo o comprimento utilizado, do número de placas que se pretende fixar simultameamente. Os parafusos são apertados manualmente na unidade de modelo normal, mas podem ser estabelecidas disposições especiais para o aperto hidráulico desses parafusos.

As placas utilizadas no modelo R145 medem 212,2 cm x 84,9 cm e possuem uma área de transferência térmica de 1,3 m^2. Além do aço inoxidável e do titânio 115, é possível ainda obter placas de titânio 260, Incoloy 825, Hastelloy C, metal Monel e níquel 200.

Temperaturas e pressões de funcionamento

Alguns Cabiadores de Calor a Placas Paraflow são construídos para funcionarem a pressões máximas de 20 kg/cm^2, mas o modelo típico destina-se, na maior parte dos casos, a suportar pressões de funcionamento de cerca de 10 kg/cm^2 — um pouco menos em certos modelos, um pouco mais em outros. A temperatura máxima é, normalmente, de cerca de 150° - 160° C. A temperatura de funcionamento é determinada pelo material de que são feitas as juntas das placas — geralmente uma borracha sintética ou elastomer, como o nitrilo, butilo, borracha de cloroprene (neoprene), ou estireno-butadieno. Os silicones e as borrachas sintéticas dos tipos Viton e EPDM (etileno propileno dieno metileno) permitem aumentar os níveis de temperatura para cerca de 170° - 180° C. Algumas unidades estão equipadas com juntas fabricadas com fibra de amianto comprida, e nestes casos a temperatura limite é elevada para cerca de 250° C. Como é óbvio, o material utilizado nas juntas vedantes tem que satesfazer às propriedades químicas do líquido do processo industrial respectivo, assim como à temperatura.

Aquecimento e arrefecimento numa única unidade

Uma outra característica importante dos termo-permutadores de placas é a possibilidade, em muitos, de se executar mais de uma operação de aquecimento ou arrefecimento numa única unidade. Isto pode ser feito simplesmente pelo acrescentamento de placas de ligação intermédias equipadas com conexões suplementares para líqudos, as quais permitem que vários líquidos sejam introduzidos ou retirados da unidade para se efectuarem operações múltiplas de transferência térmica. Este tipo de disposição, além de possibilitar que um único permutador Paraflow seja utilizado para várias funções inteiramente independentes, permite ainda que o calor extraído numa operação de de arrefecimento seja aplicado no preaquecimento de líquido destinado a outros fins.

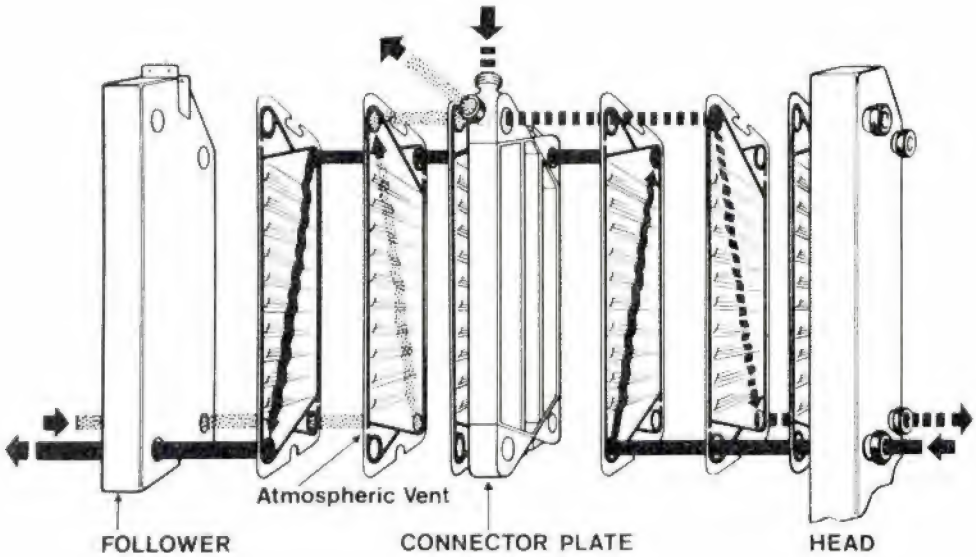

Diagram 3

Feiras, Conferências, Exposições e Congressos

OBJECTIVOS E PROGRAMA	LOCAL, DATA, ORGANIZAÇÃO E INFORMAÇÕES
Salon de L'éctronique Industrielle e de L'industrie életrotéchnique	Bâle - Suíça 9 a 13 de Setembro - 75 INELTEC
And Int. Conference on Applications of Statistics and Probability to soil and Structural Engineering	Aachen (Alemanha Ocidental) 15 a 18 Setembro - 75
4.° European Symposium on Corrosion Inhibitors	Ferrara - (ITÁLIA) 15 a 19 de Setembro - 75
SURFACE Salão Internacional para Tratamentos de Superfícies	Basileia 30 de Setembro a 4 de Outubro - 75

Resumo dos Artigos publicados na «Técnica» n.º 426

Ano L — Maio 1975

C. D. U. 621.396.65

JOSÉ A. C. SARAIVA MENDES

ESTUDO DA PROPAGAÇÃO DA BANDA DOS 11 GHz PARA LIGAÇÕES POR SATÉLITE

Técnica N.º 426 — L — 5-1975, p. 289 a 296

Este trabalho descreve as medidas feitas nos arredores de Milão com vista a determinar a viabilidade de comunicações por satélite na banda dos 11 GHz.
Como fonte de sinal, usou-se o ruído galáctico, medindo a atenuação sofrida durante períodos de chuva intensa. A partir de medidas feitas, foi possível determinar as distribuições cumulativas de atenuação e temperatura de ruído espacial, para o período estivo de 1971.

C. D. U. 001+62:629.19

O. M. BELOTSERKOVSKII

O ESPAÇO E O PROGRESSO CIENTÍFICO E TECNOLÓGICO

Técnica N.º 426 — L — 5-1975, p. 305 a 312

O autor considera a influência que as explorações especiais tiveram sobre o progresso da Ciência e da Tecnologia, chamada a atenção para a importância crescente das ciências básicas na engenharia e para o desenvolvimento de métodos de cálculo capazes de tratar problemas extremamente complexos. Todo este progresso veio trazer novas exigências ao ensino de todos os graus, e especialmente ao ensino superior, e por novos meios tecnológicos à disposição da educação. Quanto a este último ponto, o autor dá especial relevo à utilização da televisão educativa em conjugação como satélites artificiais.

C. D. U. 531.7.083:533.6.015

D. F. G. DURÃO e J. H. WHITELAW

MEDIÇÕES DE VELOCIDADE EFECTUADAS NA ZONA DE RECIRCULAÇÃO A JUSANTE DE UM DISCO

Técnica N.º 426 — L — 5-1975, p. 297 a 304

São apresentadas medições da componente axial da velocidade, efectuadas a jusante de um disco colocado perpendicularmente a um jacto de ar dando-se atenção especial à zona de recirculação. As medições foram obtidas com um anemómetro de laser incorporando uma célula acusto-óptica, a qual permitia modular a frequência do raio laser e, por conseguinte, obter medições em regiões de velocidade muito perto de zero e de alta intensidade de turbulência.
Foram usadas três maneiras diferentes de analisar o sinal saído do fotomultiplicador e os resultados foram bastante coincidentes. Duas delas foram baseadas no analisador de frequências; uma usando-o no modo analógico usual e outra usando-o juntamente com um contador de impulsos. O terceiro método usado foi o de medir a frequência de cada um dos sinais doppler e «on-line» de modo a obter os valores da média e do desvio padrão.

Synopsis of articles published in «Técnica» n.° 426

L — May 1975

U. D. C. 001+62:629.19

O. M. BELOTSERKOVSKII

SPACE AND SCIENTIFIC AND TECHNOLOGICAL PROGRESS

Técnica N.° 426 — L — 5-1975, p. 305 a 312

The influence of space explorations on the progress of Science and Technology is considered in the paper. Attention is called to the increasingly higher importance of basic sciences in engineering an to the development of computation methods capable of dealing with extremely complex problems. All such progress put new demands on all degrees of education, and especially on higher education, and also made new technological tools available to teaching. In what concerns this last point, especial emphasisi is put on the use of educational television associated with artificial satelites.

U. D. C. 621.396.65

JOSÉ A. C. SARAIVA MENDES

PROPAGATION MEASUREMENTS ON THE 11 GHz BAND FOR SATELLITE COMMUNICATIONS

Técnica N.° 426 — L — 5-1975, p. 289 a 296

This paper reports the measurements carried out in the suburbs of Milan, in order to study the possibility of establishing satellite communications on the 11 GHz band.
It has been measured the irreducible sky noise taken as a signal source. Through these measurements it has been possible the determination of cumulative distributions of attenuation and sky noise temperature for the summer period of 1971.

U. D. C. 531.7.083:533.6.015

D. F. G. DURÃO e J. H. WHITELAW

MEASUREMENTS IN THE REGION OF RECIRCULATION BEHIND A DISC

Técnica N.° 426 — L — 5-1975, p. 297 a 304

Measurements of the axial velocity component are reported downstream of a disc baffle surrounded by annular jet. Particular attention is paid to the recirculation zone. The measurements were obtained with a laser anemometer incorporanting an acousto-optic cell which allowed light-frequency shifting and, therefore, measurements in regions of near zero velocity and high turbulence intensity. Three signal-processing arrangements were used and yielded measurements which were in close agreement. Two of the signal processing arrangements made use of a frequency analyser; first in the normal analogue manner and second in a counting mode. The third arrangement made use of a computing counter.

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